



Vel Tech

Rangarajan Dr. Sagunthala
R&D Institute of Science and Technology
(Deemed to be University Estd. u/s 3 of UGC Act, 1956)

B.Tech Programme Computer Science and Engineering

**CHOICE BASED CREDIT SYSTEM
[CBCS]**

Regulation VTUR15

Curriculum and Syllabus



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Department of CSE

VISION AND MISSION OF THE DEPARTMENT

VISION

To produce intellectual graduates who could contribute significantly in the analysis, design, development, operation and maintenance of complex software systems for meeting the ever changing requirements and to compete globally towards professional excellence.

MISSION

The mission of Computer Science and Engineering Department is to

M1: Design curricula for imparting training in adapting newer computing methods and technologies for providing effective and efficient solutions to the existing / new problems.

M2: Inculcate in-depth knowledge of various courses by employing Information and Communication Technology (ICT) based pedagogy methods.

M3: Create a conducive research environment for making technological innovations by the faculty and students.

M4: Provide leadership skills and professional ethics thereby making a prolific career in academics and industry.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs for CSE)

PEO1	Will formulate, solve and analyze Computer Science and Engineering problems using necessary mathematical, Scientific and engineering fundamentals.
PEO2	Will demonstrate the impact of cutting-edge technologies to accomplish social and professional responsibilities.
PEO3	Will demonstrate critical thinking, communication, teamwork, leadership skills and ethical behavior necessary to function productively and professionally.
PEO4	Will pursue higher education at reputed institution in India and abroad, work in product development companies and engage in lifelong learning.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

- 1. Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- 2. Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
- 3. Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal and environmental considerations.
- 4. Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- 5. Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

On successful completion of the program, the graduates will be able to,
PSO1: Mathematical Concepts: Equipped with the knowledge to infer the mathematical models for problem solving using data structures, design and analysis of algorithms.

PSO2: Software Development: Exhibit proficiency to analyze, design and develop applications in various domains to provide solutions using innovative ideas.

PSO3: Transferring Skills: Demonstrate the ability to provide solutions for real world problems through acquaintance and hands-on training

Minimum credits required in course categories

Course Category	Minimum Credits Required
Foundation courses	60
Programme core	60
Programme elective	18
Allied elective	6
University elective	10
Value education elective	4
Independent learning	20
Industry/Higher Institute Learning Interaction	2
Total	180



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B.Tech - COMPUTER SCIENCE AND ENGINEERING

CBCS CURRICULUM

VTU-R15

S.No	Course Code	Program Core	L	T	P	C	Page No
1	1151CS101	{HYPERLINK \l "cm"}	3	0	0	3	13
2	1151CS102	{HYPERLINK \l "s"}	3	0	0	3	16
3	1151CS103	{HYPERLINK \l "jp"} in Java	3	0	0	3	19
4	1151CS117	{HYPERLINK \l "jp"}	3	0	0	3	22
5	1151CS104	{HYPERLINK \l "de"}	3	0	0	3	25
6	1151CS105	{HYPERLINK \l "ss"}	3	0	0	3	28
7	1151CS106	{HYPERLINK \l "daa"}	3	0	0	3	31
8	1151CS119	Introduction to Design and Analysis of Algorithm	3	0	0	3	34
9	1151CS107	{HYPERLINK \l "dbms"}	3	0	0	3	37
10	1151CS108	{HYPERLINK \l "os"}	3	0	0	3	40
11	1151CS109	{HYPERLINK \l "toc"}	3	0	0	3	43
12	1151CS110	{HYPERLINK \l "coa"}	3	0	0	3	46
13	1151CS111	{HYPERLINK \l "cn"}	3	0	0	3	49
14	1151CS112	{HYPERLINK \l "oose"}	3	0	0	3	52
15	1151CS113	{HYPERLINK \l "cgip"}	3	0	0	3	55
16	1151CS114	{HYPERLINK \l "DWDM"}	3	0	0	3	58
17	1151CS115	{HYPERLINK \l "cd"}	3	0	0	3	61
18	1151CS116	{HYPERLINK \l "mpmc"}	3	0	0	3	64
19	1151CS118	{HYPERLINK \l "mpmc"}s	3	0	0	3	67
20	1151CS201	{HYPERLINK \l "mad"}	3	0	2	4	70
21	1151CS202	{HYPERLINK \l "ip"}	2	0	2	3	73
22	1151CS301	{HYPERLINK \l "DSLAB"}	0	0	2	1	76

23	1151CS302	{HYPERLINK \l "JPlab"}	0	0	2	1	79
24	1151CS303	{HYPERLINK \l "dbmslab"}	0	0	2	1	82
25	1151CS304	{HYPERLINK \l "oslab"}	0	0	2	1	84
26	1151CS305	{HYPERLINK \l "cnlab"}	0	0	2	1	87

B.Tech - COMPUTER SCIENCE AND ENGINEERING
Program Elective

S.No	Course Code	Program Elective	L	T	P	C	Page No
1	1152CS103	{HYPERLINK \l "np"}	3	0	0	3	97
2	1152CS105	{HYPERLINK \l "UC"}	3	0	0	3	103
3	1152CS106	{HYPERLINK \l "MC"}	3	0	0	3	106
4	1152CS108	{HYPERLINK \l "UID"}	3	0	0	3	112
5	1152CS109	{HYPERLINK \l "CBT"}	3	0	0	3	115
6	1152CS110	{HYPERLINK \l "KBDSS"}	3	0	0	3	118
7	1152CS111	{HYPERLINK \l "MS"}	3	0	0	3	121
8	1152CS112	{HYPERLINK \l "HCI"}	3	0	0	3	124
9	1152CS113	{HYPERLINK \l "CV"}	3	0	0	3	127
10	1152CS114	{HYPERLINK \l "UNIX"}	3	0	0	3	130
11	1152CS115	{HYPERLINK \l "ICT"}	3	0	0	3	133
12	1152CS117	{HYPERLINK \l "IS"}	3	0	0	3	139
13	1152CS118	{HYPERLINK \l "dandp"}	3	0	0	3	142
14	1152CS119	{HYPERLINK \l "pp"}	3	0	0	3	145
15	1152CS120	{HYPERLINK \l "CC"}	3	0	0	3	148
16	1152CS122	{HYPERLINK \l "VT"}	3	0	0	3	156
17	1152CS123	{HYPERLINK \l "SNA"}	3	0	0	3	159
18	1152CS202	{HYPERLINK \l "ST"}	1	0	2	2	165
19	1152CS126	{HYPERLINK \l "SQA"}	3	0	0	3	169
20	1152CS305	{HYPERLINK \l "AJAVA"}	0	0	4	2	172
21	1152CS128	{HYPERLINK \l "FORENSIC"}	3	0	0	3	175
22	1152CS130	{HYPERLINK \l "MAINFRAMES"}	3	0	0	3	181
23	1152CS131	{HYPERLINK \l "bea"}	3	0	0	3	185
24	1152CS201	{HYPERLINK \l "DWANET"}	2	0	2	3	188
25	1152CS133	{HYPERLINK \l "OPENSOURCELAB"}	3	0	0	3	191
26	1152CS301	{HYPERLINK \l "NWALAB"}	0	0	2	1	194
27	1152CS302	{HYPERLINK \l "sap"}	0	0	2	1	196
28	1152CS303	{HYPERLINK \l "php"}	0	0	4	2	198
29	1152CS304	{HYPERLINK \l "oracle"}	0	0	4	2	201

30	1152CS205	{HYPERLINK \l "compi"}	2	0	4	4	203
31	1152CS210	Big data analytics and Tools	3	0	2	4	233
32	1152CS212	Image Processing for Remote Sensing	3	0	2	4	240
33	1152CS163	Smartphone Computing	3	0	0	3	243
34	1152CS164	Reinforcement Learning	3	0	0	3	246
35	1152CS165	Cognitive Science	3	0	0	3	249
36	1152CS166	Wireless Sensor Networks	3	0	0	3	252
37	1152CS167	Computational Thinking	3	0	0	3	255
38	1152CS168	Wireless Body Area Networks	3	0	0	3	258
39	1152CS213	Multiagent System Design	3	0	2	4	261
40	1152CS169	Secure Engineering Systems	3	0	0	3	264
41	1152CS170	Intrusion Detection and Prevention	3	0	0	3	267
42	1152CS171	Wireless Network Security	3	0	0	3	270
43	1152CS172	Deep Learning	3	0	0	3	273
44	1152CS173	Artificial Intelligence and Fuzzy Logic	3	0	0	3	276
45	1152CS174	Green Computing	3	0	0	3	279
46	1152CS311	Competitive Coding – I	0	0	2	1	315
47	1152CS312	Competitive Coding – II	0	0	2	1	316
48	1152CS313	Competitive Coding – III	0	0	2	1	318
49	1152CS180	Introduction to FinTech	3	0	0	3	322
50	1152CS175	Rapid contextual Design	3	0	0	3	HIL
51	1152CS181	GUI design using iOS	3	0	0	3	HIL
52	1152CS225	Reverse Engineering and Product Development	1	0	2	2	
53	1152CS136	Foundations of Modern Networking	3	0	0	3	
54	1152CS138	Mobile Communications	3	0	0	3	
55	1152CS142	Digital Water Marking and Steganography	3	0	0	3	
56	1152CS143	Bitcoin and Cryptocurrency Technologies	3	0	0	3	
57	1152CS145	Principles of Information Security	3	0	0	3	
58	1152CS214	Principles of Digital Animation	3	0	2	4	
59	1152CS223	Mobile Game Development Tools	3	0	2	4	
60	1152CS308	Security tools Lab	0	0	4	2	
61	1152CS229	Bigdata Architecture and Tools	2	0	2	3	
62	1152CS195	UI and UX Design	3	0	0	3	
63	1152CS196	UiPath: Robotics Process Automation	3	0	0	3	

64	1152CS197	Front End Tools: Node Js, Angular Js	3	0	0	3	
65	1152CS198	Cloud computing Concepts	3	0	0	3	
66	1152CS314	Principles of programming logic	0	0	2	1	
67	1152CS315	Machine Learning Techniques Lab	0	0	2	1	
68	1152CS316	Python Programming lab	0	0	2	1	
69	1152CS317	Data Mining Lab	0	0	2	1	
70	1152CS182	Pattern Recognition	3	0	0	3	
71	1152CS183	IoT Networking Technologies	2	0	0	2	
72	1152CS184	Multiprocessor Programming	2	0	0	2	
73	1152CS185	New game development paradigm with Unity	2	0	0	2	
74	1152CS186	User-Centered design of the smart campus	2	0	0	2	
75	1152CS199	Mobile Game development	2	0	0	2	
76	1152CS318	Competitive Programming-II	0	0	2	1	
77	1152CS319	Competitve Programming-III	0	0	2	1	

B.Tech (CSE)- Specialization in Networking and Cyber Security

S.N o	Course Code	Course	L	T	P	C	Page No
1	1152CS104	{HYPERLINK \l "EH"}	3	0	0	3	100
2	1152CS102	{HYPERLINK \l "HSN"}	3	0	0	3	94
3	1152CS107	{HYPERLINK \l "MASN"}	3	0	0	3	109
4	1152CS209	{HYPERLINK \l "IOT"}	3	0	2	4	218
5	1152CS148	{HYPERLINK \l "mnt"}	3	0	0	3	206
6	1152CS156	{HYPERLINK \l "mct"}	3	0	0	3	209
7	1152CS101	{HYPERLINK \l "CNS"}	3	0	0	3	91
8	1152CS309	Applied Cryptography Lab	0	0	4	2	282
9	1152CS149	Probability and Queuing Models	3	0	0	3	285
10	1152CS224	Cyber Security	3	0	2	4	286
11	1152CS146	Privacy and Security in Online Social Media	3	0	0	3	289
12	1152CS161	Cyber Forensics	3	0	0	3	292
13	1152CS147	Internet Security	3	0	0	3	294
14	1152CS162	Blockchain Technology	3	0	0	3	297
15	1152CS177	Cloud Security	3	0	0	3	300
16	1152CS179	Security in IoT	3	0	0	3	302
17	1152CS176	Cyber Law and Security Issues	3	0	0	3	305

18	1152CS227	System and Network Security	3	0	2	4	307
19	1152CS141	Cyber Physical Systems	3	0	0	3	310
20.	1152CS311	Competitive Coding – I	0	0	2	1	
21.	1152CS312	Competitive Coding – II	0	0	2	1	
22.	1152CS313	Competitive Coding – III	0	0	2	1	
23.	1152CS314	Principles of programming logic	0	0	2	1	
24.	1152CS192	Windows and Linux Administration	3	0	0	3	
25.	1152CS187	Digital Forensics Methods	3	0	0	3	

The B.Tech (CSE)- Specialization in Networking and Cyber Security students must take courses 18 credits from the above mentioned list of courses

B.Tech (CSE)- Specialization in Data Analytics

S.No	Course Code	Course Name	L	T	P	C	Page No
1	1152CS121	{HYPERLINK \1 "BIG"}	3	0	0	3	151
2	1152CS137	Artificial Intelligence	3	0	0	3	228
3	1152CS116	{HYPERLINK \1 "ITRSM"}	3	0	0	3	136
4	1152CS124	{HYPERLINK \1 "SC"}	3	0	0	3	162
5	1152CS206	{HYPERLINK \1 "statisticalMethods"}	3	0	2	4	212
6	1152CS207	{HYPERLINK \1 "mlr"}	1	0	4	3	222
7	1152CS306	Map Reduce and Hadoop Tools	0	0	4	2	225
8	1152CS140	{HYPERLINK \1 "mlt"}	3	0	0	3	216
9	1152CS307	Python Programming with Data Analytics Lab	0	0	4	2	232
10	1152CS204	{HYPERLINK \1 "BI"}	3	0	2	4	178
11	1152CS139	{HYPERLINK \1 "DataScience"}	3	0	0	3	214
12	1152CS226	Sentiment Analysis	3	0	2	4	313
13	1152CS134	Marketing Analytics	3	0	0	3	
14	1152CS132	Social Network Analysis for Big Data	3	0	0	3	
15	1152CS211	Image and Video Analysis	3	0	2	4	
16.	1152CS311	Competitive Coding – I	0	0	2	1	
17.	1152CS312	Competitive Coding – II	0	0	2	1	
18.	1152CS313	Competitive Coding – III	0	0	2	1	
19.	1152CS314	Principles of Programming Logic	0	0	2	1	
20.	1152CS188	Predictive Analytics	3	0	0	3	

21.	1152CS189	Web and Mobile Analytics	3	0	0	3	
22.	1152CS191	Data Visualization	3	0	0	3	
23.	1152CS232	Tensor Flow for Deep Learning	2	0	2	3	
24.	1152CS194	Text and Social Media Analytics	3	0	0	3	
25.	1152CS190	Time Series Analysis	3	0	0	3	
26.	1152CS229	Big Data Architecture and Tools	2	0	2	3	
27.	1152CS210	Big Data Analytics and Tools	2	0	2	3	

The B.Tech (CSE)- Specialization in Data Analytics students must take courses 18 credits from the above mentioned list of courses

B.Tech (CSE) - Specialization in Animation and Game Design.

S.No	Course Code	Course Name	L	T	P	C	Page No
1	1152CS216	3D Animation	2	0	2	3	237
2	1152CS214	Principles of Digital Animation	3	0	2	4	
3	1152CS215	Virtual and Augmented Reality	3	0	2	4	
4	1152CS217	Media Animation and Visual Effects Software Tools	1	0	4	3	
5	1152CS218	2D Animation	2	0	2	3	
6	1152CS219	3D Character Modeling	2	0	2	3	
7	1152CS220	Rigging and Animation	2	0	2	3	
8	1152CS221	3D Architecture and Art Design	4	0	4	6	
9	1152CS222	3D Effects	2	0	2	3	
10	1152CS223	Mobile Game Development Tools	3	0	2	4	
11	1152CS151	Basics of Game Design	3	0	0	3	
12	1152CS150	Landscape and Set design	3	0	0	3	
13.	1152CS311	Competitive Coding – I	0	0	2	1	
14.	1152CS312	Competitive Coding – II	0	0	2	1	
15.	1152CS313	Competitive Coding – III	0	0	2	1	
16.	1152CS314	Principles of Programming Logic	0	0	2	1	

The B.Tech (CSE) - Specialization in Animation and Game Design students must take courses 18 credits from the above mentioned list of courses

B.Tech (CSE)- Specialization in Financial Computing

S.No	Course Code	Course Name	L	T	P	C	Page Number
1	1152CS180	Introduction to FinTech	3	0	0	3	322
2	1152CS152	Basics of Financial Mathematics	3	0	0	3	
3	1152CS153	Financial Management	3	0	0	3	
4	1152CS154	Management Accounting	3	0	0	3	
5	1152CS155	Financial Data Analytics	3	0	0	3	
6	1152CS157	Algorithmic Trading	3	0	0	3	
7	1152CS159	Risk and Valuation	3	0	0	3	
8	1152CS160	Artificial Intelligence in Financial Technology	3	0	0	3	
9	1152CS162	Block chain and Distributed Ledgers	3	0	0	3	
13.	1152CS311	Competitive Coding – I	0	0	2	1	
14.	1152CS312	Competitive Coding – II	0	0	2	1	
15.	1152CS313	Competitive Coding – III	0	0	2	1	
16.	1152CS314	Principles of Programming Logic	0	0	2	1	

The B.Tech (CSE)- Specialization in Financial Computing students must take courses 18 credits from the above mentioned list of courses

B.Tech - COMPUTER SCIENCE AND ENGINEERING ALLIED ELECTIVE CURRICULUM

S.No	Course Code	Allied Elective	L	T	P	C	Page No
1	1153CS101	Basic Computer System Organization and Architecture	3	0	0	3	283
2	1153CS102	Operating System	3	0	0	3	286
3	1153CS103	Object Oriented programming	3	0	0	3	289
4	1153CS104	Data Structures Using C	3	0	0	3	292
5	1153CS105	Web Designing	3	0	0	3	295
6	1153CS106	Cloud Computing	3	0	0	3	298
7	1153CS107	E Commerce	3	0	0	3	301
8	1153CS108	Programming in JAVA	3	0	0	3	304
9	1153CS109	Green Computing	3	0	0	3	307
10	1153CS110	Fundamentals of IoT	3	0	0	3	310
11	1153CS301	Python Programming Lab	0	0	2	1	313
12	1153CS201	Object Oriented Paradigm for Product Development	4	0	4	6	
13	1153CS202	Web Design for IoT	4	0	4	6	

B.Tech - COMPUTER SCIENCE AND ENGINEERING
INSTITUTE ELECTIVE CURRICULUM

S.No	Course Code	Institute Elective	L	T	P	C	Page No
1	1154CS101	Computer Networks	3	0	0	3	316
2	1154CS102	Java Programming for Engineers	3	0	0	3	319
3	1154CS103	C++ Programming	3	0	0	3	322
4	1154CS104	Android Mobile Application Development	3	0	0	3	325
5	1154CS105	Software Engineering	3	0	0	3	328
6	1154CS106	Data Structures	3	0	0	3	332
7	1154CS201	Problem Solving using C++	2	0	4	4	334
8	1154CS301	Mobile App Development using Android Studio	0	0	2	1	337
9	1154CS203	Android Programming	2	0	4	4	339
10	1154CS204	Coding Techniques I	2	0	2	3	342
11	1154CS205	Coding Techniques II	2	0	2	3	344
12	1154CS107	Fundamentals of IoT	3	0	0	3	345

B.Tech - COMPUTER SCIENCE AND ENGINEERING
VALUE EDUCATION ELECTIVE

S.No	Course Code	Institute Elective	L	T	P	C	Page No
1	1155CS101	Ethics in Engineering	1	0	0	1	389
2	1155CS102	Computer Ethics	1	0	0	1	

PROGRAM

CORE

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS101	CONCRETE MATHEMATICS	3	0	0	3

Course Category: Program Core

A. Preamble:

{PAGE }

This course provides an introduction to the basic concepts and techniques of numerical methods, graph theory, random variables, Marko processes properties, distribution, queuing models non-markovianqueuing models and their inter-relations and applications to computer science engineering, and science areas; introduce students to cognitive learning in mathematics; and develops problem solving skills with both theoretical and computer science engineering-oriented problems.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150MA202	Engineering Mathematics I

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Apply numerical methods to find our solution of algebraic equations using different methods under different conditions, and numerical solution of system of algebraic equations.	K3
CO2	Solve problems involving graph models, connectivity paths, connectedness in undirected and directed graphs, Euler and Hamilton paths. shortest-path problem,Trees,Connected Trees	K3
CO3	Calculate probabilities, random processes, stationary randomprocesses, autocorrelation and cross-correlation functions and ergodic processes	K3
CO4	Identify the nature of the process namely Binomial, Poisson, Normal, Markov, Sine wave processes and calculate stationary and transition probabilities.	K3
CO5	Apply the concept of Markovian Queueing models and the concept of non-Markovian queues for obtaining measures of performance of real-time problems under steady state	K3

	conditions	
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E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M											L	L		L
CO2		M		L									H		M
CO3		L													
CO4						L							L		M
CO5											M				L

H- High; M-Medium; L-Low

F. Course Content:

UNIT I Linear Algebraic Equation and Eigen Value Problems

9

System of equations–solution by Gauss elimination, Gauss-Jordan and LU decomposition method–Jacobi, Gauss-Seidel iteration methods–finding Eigen values of a matrix by Jacobi and power methods Non-Linear system of equations: Graphical method-Newton-Raphson Method-modified Newton-Raphson Method-Method of steepest descent method.

UNIT II Graphs

9

Simple graphs and multi-graphs – directed multi-graphs – graph models – handshaking theorem – some simple special graphs – representing graphs and graph isomorphism – adjacency and incidence matrices – connectivity paths – connectedness in undirected and directed graphs – Euler and Hamilton paths – shortest-path problems- Trees-Connected Trees

UNIT III Random Processes

9

Finite probability – probability distributions – conditional probability – independence – Bayes' theorem – mathematical expectation-Definition and description – random processes – stationary random processes – autocorrelation and cross-correlation functions and their properties – ergodic processes

UNIT IV Special Random Processes

9

Sine wave process – binomial, Poisson and normal processes – Markov process – Markov chains – transition probability matrix – steady-state distribution – classification of states of Markov chains – birth and death process

UNIT V Queueing Theory

9

Basics of queueing models – (M-M-1) :(∞ /FIFO) model - (M-M-s) :(∞ /FIFO) model -(M-M-1) :(k/FIFO) model - (M-M-s):(k/FIFO) model – (M-G-1) queueing model – Pollaczek-Khinchine formula

TOTAL: 45 Periods

G. Learning Resources

i. Text Books:

1. S.M. Ross, "Introduction to Probability Models", eighth edition, Academic Press, San Diego, 2004.
2. B.S. Grewal, "Numerical Methods in Engineering and Science", eighth edition, Khanna Publishers, New Delhi, 2008
3. John J. Shynk, Probability, Random Variables, and Random Processes: Theory and Signal, Wiley, 2012.
4. Scott L. Miller, Donald and G. Childers, Probability and Random Processes: With Applications to Signal Processing and Communications, Academic Press, 2012.
5. Kishor S. Trivedi, Probability & Statistics with Reliability, Queuing and Computer Applications, Second Edi., Prentice Hall of India ,2008.
6. Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, Probability & Statistics for Engineers & Scientists, Prentice Hall, 9th Edi., 2010.
7. P.Z.PeeblesJr.Probability, Random Variables are Random Signal Principles, Tata McGraw Hill, New Delhi,2002

ii. Online resources

1. www.algebra.com → {HYPERLINK "http://www.algebra.com/algebra"} → {HYPERLINK "http://www.algebra.com/algebra/college"} → {HYPERLINK "http://www.algebra.com/algebra/college/linear"}
2. {HYPERLINK "http://www.richland.edu/james/lecture/m116/matrices/pivot.html"}
3. {HYPERLINK "http://www.youtube.com/watch?v=wTlAUfv_O4s"}
4. {HYPERLINK "http://www.sfb649.wiwi.hu-berlin.de/fedc_homepage/xplore/.../node39.htm"}
5. {HYPERLINK "http://www.ergodic.ugr.es/cphys/LECCIONES/FORTRAN/power_method.pdf"}
6. {HYPERLINK "http://www.cs.cornell.edu/home/kleinber/networks-book/networks-book-ch02.pdf"}
7. {HYPERLINK "http://www.math.fsu.edu/~pkirby/mad2104/SlideShow/s6_2.pdf"}
8. {HYPERLINK "http://www.mathcove.net/petersen/lessons/get-lesson?les=2"}
9. {HYPERLINK "http://www.am.qub.ac.uk/users/g.gribakin/sor/Chap1a.pdf"}

10. {HYPERLINK "http://www.slideshare.net/guest44b78/probability-concepts-applications"}
11. {HYPERLINK "http://www.vassarstats.net/bayes.html"}
12. {HYPERLINK "http://www.borooah.com/Teaching/Microeconomics/Bayes.pdf"}
13. {HYPERLINK "http://www.ccs.neu.edu/course/.../Probability/ConditionalProbability.pdf"}
14. www.cems.uvm.edu/~dben/chris_probability.ppt - united states
15. en.wikipedia.org/wiki/moment-generating_function
16. {HYPERLINK "http://www.courses.ncssm.edu/math/stat_inst/pdfs/sec_2_f.pdf"}
17. www.statlect.com › additional topics in probability theory

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS102	DATA STRUCTURES	3	0	0	3

Course Category: Program Core

A. Preamble:

This course provides an introduction to the basic concepts and techniques of Linear and nonlinear data Structures and Analyze the various algorithm.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS105	System Software
2	1151CS106	Design and Analysis of Algorithm
3	1151CS119	Introduction to Design and Analysis of Algorithms
4	1151CS107	Database Management System
5	1151CS108	Operating Systems
6	1151CS111	Computer Networks

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Identify and explain user defined data types, linear data structures for solving real world problems.	K2
CO2	Design modular programs on non linear data structures and algorithms for solving engineering problems efficiently.	K3
CO3	Illustrate special trees and Hashing Techniques.	K2
CO4	Apply searching techniques in graph traversal	K3
CO5	Apply sorting techniques for real world problems.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H		M		L	M	M		M	M		M	M	M	L
CO2	M	M	M	M	L			M		M			M	M	L
CO3	M	M	M	L	L	M	L						M	M	M
CO4	M		M		L			M					M	M	H
CO5	M	M	M	L	L			M	M				M	M	H

H- High; M-Medium; L-Low

F. Course Content:

UNIT I LINEAR DATA STRUCTURE

L – 9

Introduction - Time and space complexity analysis - Abstract Data Type (ADT) – The List ADT – Array Implementation – Linked List Implementation– the Stack ADT – The Queue ADT – Applications of Stack, Queue and List.

UNIT II TREES

L – 9

Introduction to trees - Tree Traversal - Binary Trees - Definitions – Expression Tree – Binary Tree Traversals - The Search Tree ADT – Binary Search Trees - AVL Tree.

UNIT III SPECIAL TREES & HASHING

L – 9

Splay Tree – B-Tree - Priority Queue - Binary Heap – Hashing - Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing – Rehashing

UNIT IV GRAPH

L – 9

Introduction to Graphs - Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths –Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm- Kruskal's Algorithm – Breadth first search – Depth-First Search – Undirected Graphs – Biconnectivity.

UNIT V SORTING& SEARCHING

L – 9

Sorting algorithm- Insertion sort- Selection sort- Shell Sort-Bubble sort- Quick sort- Heap sort-Merge sort- Radix sort - Searching – Linear search - Binary search.

Total: 45 Periods

G. Learning Resources

i. Text Books:

{PAGE }

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2007.

ii. Reference:

1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition Reprint 2003.
2. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2005.
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structure", Computer Science Press, 1995.

iii. Online resources

1. <http://simplenotions.wordpress.com/2009/05/13/java-standard-data-structures-big-o-notation/>
2. {HYPERLINK "http://mathworld.wolfram.com/DataStructure.html/"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS103	PROGRAMMING IN JAVA	3	0	0	3

Course Category: Program Core

A. Preamble:

Most of the software need to develop runs in cross platform. Java is the one of the pioneer software development tool developed used for cross platform development software. From the system towards the handheld devices all place Java become one of the most dominant software. This course provides a basic concept about Object Oriented Programming, Database connectivity, Networking and finally provides programming skills in java. After successful completion of this course learners can able to develop software modules for real world problem.

B. Pre-requisites:

Sl No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl No	Course Code	Course Name
1	1151CS201	{HYPERLINK \l "mad"}
2	1151CS202	{HYPERLINK \l "ip"}

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Design and implement basic data types and control flow constructs using J2SE or other Integrated Development Environments.	K2
CO2	Write, compile and execute Java programs using object oriented class structures with parameters, constructors, and utility and calculations methods, including inheritance, test classes and exception handling.	K2
CO3	Demonstrate multitasking using Threads.	K3
CO4	Develop simple applications using GUIs and event driven programming	K2

CO5	Develop applets for inclusion in web pages; applets to access enterprise data bases in robust, enterprise applications	K3
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E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M											
CO2	M		M	M								
CO3	M											
CO4	M		M	L	M							
CO5	M		M	M	M							

H- High; M-Medium; L-Low

F. Course content:

UNIT I: INTRODUCTION TO JAVA

L- 9

Basic concepts of object oriented programming, Java vs C++, Tokens ,Keywords , Identifiers, Data types , Type Conversions and Casting, Arrays and Operators, Control statements, Class fundamentals, constructors , this keyword, garbage Collection and finalize methods,overloading methods

UNIT II: INHERITANCE AND PACKAGE

L- 9

Nested and Inner Classes, Basics of Inheritance, Super keyword, Multilevel Hierarchy, Invoking Constructors, Method overriding, Abstract Classes, Using Final with Inheritance, Packages, Interfaces, String Operations.

UNIT III: EXCEPTIONS AND THREADS

L- 9

Exception Types, Uncaught Exceptions, Using Try Catch, Multiple Catch, Nested Try and throw, Throws, finally, Threads.

UNIT IV: I/O STREAMS AND APPLET

L- 9

Character Streams, Stream I/O, Serialization, Files, Applet Architecture, Programming using Applet, Event Handling-Delegation event Model-Event Classes-Event Listener Interface

UNIT V: JAVA NETWORKING AND JDBC

L- 9

InetAddress –TCP/IP Client socket – URL Connection –TCP/IP Server - socket – Datagram, JDBC-JDBC Drivers,Database connectivity in Java.

TOTAL : 45 Periods

G. Learning Resources

i. Text Books

- 1.E. Balaguruswamy,*Programming in java* , Fourth Edition,TMH,2010.
2. PatricNaughton , Herbert Schildt, The Complete Reference “Java 2 ”, Ninth edition, Tata McGraw Hills ,2014.

ii. Reference Books

1. H.M.Deitel and P.J.Deitel –“**Java How to Program**” Pearson Prentice Hall Sixth Edition, 2011.
2. Sachinmalhotra, "Programming in JAVA", Oxford University Press, 2011.
3. Maydene Fisher, Jonathan Ellis, Jonathan Bruce,"*JDBC Database access with java*" Addison-Wesley, Third Edition 2003
4. Bruce Eckel – “**Thinking in Java**” Pearson Prentice Hall Third Edition-2006

iii. Online Resources

1. docs.oracle.com/javaee/6/tutorial/doc/girgm.html
2. www.webreference.com/programming/java.html
3. www.apl.jhu.edu/~hall/java/Documentation.html

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS117	JAVA PROGRAMMING	3	0	0	3

Course Category: Program Core

A. Preamble:

Most of the software needs to develop an application which runs in cross platform. Java is the one of the pioneer software tools used for cross platform development software. Java is the most dominant software to develop web applications and distributed applications. This course provides basic concepts about Object Oriented Programming, Java Packages, Exceptions, Database connectivity, Networking, AWT and Java Servlets. After successful completion of this course learners can able to develop software modules for real world problem.

B. Pre-requisites:

S1 No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

S1 No	Course Code	Course Name
1	1151CS201	Mobile Application & Development
2	1151CS202	Internet Programming

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain Java fundamentals and Object Oriented Programming (OOP) concepts to solve problems.	K2
CO2	Apply the concepts of java packages, inheritance and exception handling mechanisms for real world problem..	K3
CO3	Solve the problems using I/O Streams, Strings, Collections and Threads concepts.	K2
CO4	Develop simple applications using GUIs and event driven programming.	K3
CO5	Experiment with database connectivity, to familiarize the advanced java programming skills and develop java based web applications.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M				L			M	L	L			L		L
CO2	M	M	L		L			H	L	L	L		L	M	L
CO3	M	H	M		L			H	M	L	M		L	M	L
CO4	M	H	M		M			H	M	L	M	M	L	M	L
CO5	M	H	H	M	H			H	H	L	H	M	L	M	M

H- High; M-Medium; L-Low

F. Course content:

UNIT I BASICS OF JAVA 9

Introduction to object-oriented programming - Features of Java - JVM- Keywords- Variables - Data types – Operators - Control statements - Classes and Methods - Objects – Access specifiers- Constructors - Method Overloading - Type Casting - this keyword- Static - Arrays.

UNIT II PACKAGE, INHERITANCE AND EXCEPTION HANDLING 9

Package Access - Java API Packages -Basics of Inheritance - Forms of Inheritance - Sub Classes and Subclass Types -Super keyword – Final - Method Overriding - Abstract Classes - Interfaces.

Exception Handling: Java Exception Hierarchy - Exception Types - Throwing and Catching exceptions -Declaring New Exception Types.

UNIT III I/O STREAMS, STRINGS AND COLLECTIONS 9

Character Streams - Stream I/O - Serialization – Files – String Class - String handling - java. util. Collections - Collections Frameworks - Generic Classes and Methods.

UNIT IV AWT AND THREADS 9

Applets: Basics of applets - Applet Architecture - Life cycle of an Applet – AWT: Event Handling-Delegation event Model.

Threads: Thread priority - Thread operations - Thread states – Thread Synchronization - Basics of Java Networking.

UNIT V: JDBC AND SERVLET 9

JDBC: JDBC Architecture - JDBC Drivers- Database connectivity in Java- HTML basics - JavaScript basics.

Servlets: Servlet Architecture - Life cycle of a Servlet - The Servlet API- Handling HTTP Request and Response- Cookies - Session Tracking-Overview of JSP.

TOTAL: 45

G. Learning Resources

i. Text Books

1. Herbert Schildt, "Java the Complete Reference", Ninth edition, Tata Mc-GrawHill ,2014.
2. Cay S. Horstman and Gary Cornell, "Java: Core Java 2 Vol. 1: Fundamentals", Sun Microsystems Press, Seventh Edition.

ii. Reference Books

1. H.M. Deitel and P.J. Deitel," Java How to Program", Pearson Prentice Hall Seventh Edition.
2. E. Balaguruswamy, "Programming in java", Fourth Edition, Tata McGraw Hill,2010
3. Jason Hunter, William Crawford," Java Servlet Programming", Second Edition, O'Reilly
4. Kathy Sierra, Bert Bates: "Head First Java- A Learners Guide", Second Edition, O'Reilly
5. Kathy Sierra, Bert Bates , "SCJP- Sun certified programmer for Java 6 study Guide", Tata Mcgraw Hill.

iii. Digital Resources

1. {HYPERLINK "<http://www.w3schools.com/>" \h}/
2. {HYPERLINK "<https://www.javatpoint.com/>" \h}
3. {HYPERLINK "<https://www.tutorialspoint.com/java/>" \h}
4. {HYPERLINK "https://www.sanfoundry.com/java-questions-answers-freshers-experienced/"}
5. {HYPERLINK "<http://codingbat.com/java>"}/

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS104	DIGITAL ELECTRONICS	3	0	0	3

Course Category: Program Core

A. Preamble:

The primary aim of this course is to understand the fundamentals behind the digital logic design. From that students can gain the experience, to design any digital circuits and systems. The course includes fundamentals of Boolean algebra, combinational, sequential circuits and applications of digital electronics. Students can learn the basic programming concepts to implement digital circuits using hardware description language.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150EE302	Basic Electronics Engineering

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS110	{HYPERLINK \l "coa"}
2	1151CS116	{HYPERLINK \l "mpmc"}
3	1151CS118	{HYPERLINK \l "mpmc"}s

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Apply the simplification of Boolean expressions using K – Map method and designing Combinational circuits.	K3
CO2	Outline the combinational building blocks & memory elements.	K2
CO3	Design the combinational and sequential circuits using hardware description language.	K3
CO4	Solve the asynchronous sequential circuits for given applications	K2
CO5	Explain the applications of digital electronics	K2

E. Correlation of COs with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	M			M					L			H		L
CO2	M	M			M					L			L		
CO3	H			M	H			L						M	
CO4	M	M											M		
CO5	M	M			M			L					L		L

H- Strong; M-Medium; L-Low

F. Course Content:

UNIT-I DIGITAL FUNDAMENTALS AND COMBINATIONAL CIRCUITS 10

Introduction to Boolean algebra and Switching Functions; Boolean Minimization using K Map and Tabulation method; **combinational circuits:** Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder– Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT -II SEQUENTIAL CIRCUITS 10

Flip Flops and Memory devices: RAM – Static and Dynamic, ROM, PROM, EPROM, EEPROM; **Counters and Shift registers:** Binary, BCD and programmable modulo counters, Shift register counters; **Sequential circuit design:** using Mealy and Moore model.

UNIT III INTRODUCTION TO HARDWARE DESCRIPTION LANGUAGE 10

Introduction to Verilog / VHDL- Structural, Dataflow and Behavioral modeling. Structural, Dataflow and Behavioral modeling of combinational logic circuits (Multiplexer, Demultiplexer, decoder and encoder). Structural, Dataflow and Behavioral modeling of sequential logic circuits (counters and shift registers).

UNIT IV ASYNCHRONOUS SEQUENTIAL CIRCUITS 10

Analysis Procedure, Circuits with latches; Design Procedure, Reduction of state and flow table; Race free state assignment; Hazards; ASM chart; Design examples.

UNIT V APPLICATIONS OF DIGITAL ELECTRONICS**5**

Multiplexing displays - Frequency counters - Time measurements - using the ADC0804 - Slope alone operation, span adjust, zero shift, testing - microprocessor compatible A/D converters.

TOTAL: 45 Periods**G. Learning Resources:****i. TEXTBOOKS**

1. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. Donald. P.Leach, Digital principles and applications, 7th Edition, McGraw-Hill ,2012

ii. REFERENCE:

1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006.
2. Thomas L. Floyd, Digital Fundamentals, 8th Edition, Pearson Education Inc, New Delhi, 2003 Donald D.Givone, Digital Principles and Design, TMH.
3. William H. Gothmann, Digital Electronics, 2nd Edition, PHI, 1982.

iii. Online resources

1. {HYPERLINK "http://www.wiley.com/legacy/wileychi/mblin/supp/student/LN08CombinationalLogicModules.pdf"}
2. {HYPERLINK "http://www.learnabout-electronics.org"}
3. {HYPERLINK "http://www.nptel.com/digitalelectronics/iitkanpur/"}
4. {HYPERLINK "http://www.mooc.org"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS105	SYSTEM SOFTWARE	3	0	0	3

Course Category: Program Core

A. Preamble:

This Course provides System software and machine architecture, a simple SIC assembler and algorithm types of assembler, Basic loader functions, Program Linking, Basic macro processor functions and Text editors.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK "file:///C:/Users/Multimedia/Downloads/SS_Syllabus.docx" \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS110	{HYPERLINK "file:///C:/Users/Multimedia/Downloads/SS_Syllabus.docx" \l "coa"}

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain the architecture of SIC and SIC/XE.	K2
CO2	Translate the given mnemonic into object code	K2
CO3	Illustrate how the object code is loaded into memory and linked with other object code	K2
CO4	Summarize the macro definitions and its expansions	K2
CO5	Explain Editing and debugging Tools.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H														
CO2	M	M	L										M		
CO3	M	M											M		

CO4	M	M	L									L		
CO5	M				M									

H- Strong; M-Medium; L-Low

F. Course Content:

UNIT I INTRODUCTION

L - 8

System software and machine architecture – The Simplified Instructional Computer (SIC) - Machine architecture - Data and instruction formats - addressing modes - instruction sets - I/O and programming.

UNIT II ASSEMBLERS

L - 10

Basic assembler functions - A simple SIC assembler – Assembler algorithm and data structures - Machine dependent assembler features - Instruction formats and addressing modes – Program relocation - Machine independent assembler features - Literals – Symbol-defining statements – Expressions - Implementation example - MASM assembler.

UNIT III LOADERS AND LINKERS

L - 9

Basic loader functions - Design of an Absolute Loader – A Simple Bootstrap Loader - Machine dependent loader features - Relocation – Program Linking – Algorithm and Data Structures for Linking Loader - Machine-independent loader features - Automatic Library Search – Loader Options - Loader design options - Linkage Editors – Dynamic Linking.

UNIT IV MACRO PROCESSORS

L - 9

Basic macro processor functions - Macro Definition and Expansion – Macro Processor Algorithm and data structures - Machine-independent macro processor features - Concatenation of Macro Parameters – Generation of Unique Labels – Conditional Macro Expansion – Keyword Macro Parameters-Macro within Macro-Implementation example - MASM Macro Processor.

UNIT V SYSTEM SOFTWARE TOOLS

L - 9

Text editors - Overview of the Editing Process - User Interface – Editor Structure. - Interactive debugging systems - Debugging functions and capabilities – Relationship with other parts of the system – User-Interface Criteria.

TOTAL: 45 Periods

G. Learning Resources

i. TEXT BOOK:

1. Leland L. Beck, "System Software – An Introduction to Systems Programming", 3rd Edition, Pearson Education Asia, 2006.

ii. REFERENCES:

1. D. M. Dhamdhere, "Systems Programming and Operating Systems", Second Revised Edition, Tata McGraw-Hill, 2000.
2. John J. Donovan "Systems Programming", Tata McGraw-Hill Edition, 2000.
3. John R. Levine, "Linkers & Loaders" – Harcourt India Pvt. Ltd., Morgan Kaufmann Publishers, 2000.

iii ONLINE RESOURCES

1. {HYPERLINK "<http://www.edunotes.in/system-software-notes>"}
2. {HYPERLINK "<http://www.faadooengineers.com/.../7960-System-Software-Ebook-Notes-pdf>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS106	DESIGN AND ANALYSIS OF ALGORITHM	3	0	0	3

Course Category: Program Core

A. Preamble :

For an engineer, problem solving is not about just solving a problem somehow but about solving the problem in the most effective and efficient way. Two key skills that a software professional needs are (1) to choose suitable data structures to store the information part of the problem, and (2) use of efficient algorithms for developing a programming solution of a given problem. Selection of a particular data structure greatly influences the characteristics of the obtained solution that include efficiency (performance, or speed), space (memory) requirements, scalability, reuse, and robustness (or reliability). The other equally important skill is to choose a suitable problem solving technique to apply to a particular problem. Acquiring these skills, greatly enhances the problem solving skills of the learner.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain various asymptotic notations and Compute the efficiency of given algorithms	K2

CO2	Apply the brute force technique to solve the given problem	K3
CO3	Use DAC technique to solve a given problem.	K3
CO4	Compute optimum solutions for the given problem.	K3
CO5	Apply B&B and B&T technique to solve combinatorial problem	K3
CO6	Discuss the improvement of computational efficiency using iterative approaches	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	H	M	L	L								
CO2			M	L	L							
CO3		M	M	M		L						
CO4		M	M	M	L	L						
CO5		M	M	L	L		L					
CO6		M		M	L	L						

F. Course Content:

UNIT I INTRODUCTION 9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations– Mathematical analysis for Recursive and Non-recursive algorithms.

UNIT II BRUTE FORCE AND DIVIDE-AND-CONQUER 9

Brute Force: Closest-Pair Problems- Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem. Divide and conquer methodology: Merge sort – Quick sort – Binary search.

UNIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE 9

Dynamic Programming: Computing Binomial Coefficient Warshall's and Floyd' algorithm – Knapsack Problem. Greedy Technique: Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm.

UNIT IV BACKTRACKING AND BRANCH & BOUND 9

Backtracking: n-Queens problem-Hamiltonian Circuit Problem - Branch and Bound: Assignment problem-Knapsack Problem- Traveling Salesman Problem

**UNIT V ITERATIVE IMPROVEMENT AND LIMITATIONS OF ALGORITHM
POWER**

9

The Maximum matching in bipartite graph. Limitations of Algorithm Power--Decision Trees- P, NP and NP-Complete Problems.

TOTAL: 45Periods

G. Learning Resources

i.Text Books:

1. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

ii. REFERENCES:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2. Donald E. Knuth, "The Art of Computer Programming", Volumes 1& 3 Pearson Education, 2009.
3. "Fundamentals of Computer Algorithms" by Ellis Horowitz, SartajSahmi, SanguthevarRajasekaran, University Press, Second Edition 2008.

iii. Online Resources:

1. <http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html>
2. <http://nptel.ac.in/courses/106101060/>
3. <https://www.coursera.org/course/algo>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS119	INTRODUCTION TO DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	3

Course Category: Program Core

A. Preamble :

For an engineer, problem solving is not about just solving a problem somehow but about solving the problem in the most effective and efficient way. Two key skills that a software professional needs are (1) to choose suitable data structures to store the information part of the problem, and (2) use of efficient algorithms for developing a programming solution of a given problem. Selection of a particular data structure greatly influences the characteristics of the obtained solution that include efficiency (performance, or speed), space (memory) requirements, scalability, reuse, and robustness (or reliability). The other equally important skill is to choose a suitable problem solving technique to apply to a particular problem. Acquiring these skills, greatly enhances the problem solving skills of the learner.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain various asymptotic notations and Compute the efficiency of given algorithms	K2

CO2	Apply the brute force technique and DAC technique to solve the given problem	K3
CO3	Construct optimum solutions for the given problem.	K3
CO4	Apply B&B and B&T technique to solve combinatorial problem	K3
CO5	Discuss the improvement of computational efficiency using iterative approaches	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	L	M	L					H					M		L
CO2	M	M	M	L	L			H	L	L			M	M	L
CO3	M	M	M	L	L			H	L	L			M	M	L
CO4	M	M	M	L	L			H	L	L			M	M	L
CO5	L	M	L					H					L		L

F. Course Content:

UNIT I INTRODUCTION

9

Notion of an Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithm Efficiency – Analysis Framework – Asymptotic Notations– Mathematical analysis for Recursive and Non-recursive algorithms.

UNIT II BRUTE FORCE AND DIVIDE-AND-CONQUER

9

Brute Force: Closest-Pair and convex-Hull Problems- Exhaustive Search - Traveling Salesman Problem - Knapsack Problem - Assignment problem.

Divide and conquer methodology: Merge sort – Quick sort – Binary search- Closest-Pair and convex-Hull Problems

UNIT III DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE

9

Dynamic Programming: Computing Binomial Coefficient - Warshall's and Floyd' algorithm – Knapsack Problem. Greedy Technique: Prim's algorithm- Kruskal's Algorithm- Dijkstra's Algorithm.

UNIT IV BACKTRACKING AND BRANCH & BOUND

9

Backtracking: n-Queens problem-Hamiltonian Circuit Problem.

Branch and Bound: Assignment problem-Knapsack Problem- Traveling Salesman Problem

UNIT V ITERATIVE IMPROVEMENT AND LIMITATIONS OF ALGORITHM**POWER**

9

The simplex method- The maximum-flow problem- The Maximum matching in bipartite graph. Limitations of Algorithm Power--Decision Trees- P, NP and NP-Complete Problems.

TOTAL: 45Periods**G. Learning Resources****i.Text Books:**

1. AnanyLevitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012.

ii. REFERENCES:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2. Donald E. Knuth, "The Art of Computer Programming", Volumes 1& 3 Pearson Education, 2009.
3. Robert EndreTarjan,"Data Structures and Network Algorithms",1983.
4. Ellis Horowitz, SartajSahmi and SanguthevarRajasekaran, "Fundamentals of Computer Algorithms" University Press, Second Edition 2008.

iii. Online Resources:

1. <http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html>
2. <http://nptel.ac.in/courses/106101060/>
3. <https://www.coursera.org/course/algo>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS107	DATABASE MANAGEMENT SYSTEM	3	0	0	3

Course Category: Program Core

A. Preamble:

This course provides demands the need for efficient storage and manipulation of data which will be used worldwide and exposed to different applications.

B. Pre-requisite:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Links to Other Courses:

Sl. No	Course Code	Course Name
1	1151CS112	Object Oriented {HYPERLINK \l "sepm"} Engineering
2	1151CS114	{HYPERLINK \l "DWDM"}
3	1152CS139	{HYPERLINK \l "DataScience"}
4	1156CS601	Minor Project
5	1156CS701	Major Project

D. Course Outcomes:

At the end of the course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Identify and explain the underlying concepts of database technologies	K2
CO2	Design and implement a database schema for a given problem-domain	K3
CO3	Apply normalization for the given database application.	K3
CO4	Illustrate the properties of transaction and recovery management.	K2
CO5	Identifies the concept of physical storage media and various types of databases.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H			L								H		
CO2	H	H	L	M	H							L	H	M	M
CO3	H	H	M	M	H	L					M	L	H	M	
CO4	H	H	L	M	M	L					M	L	H		L
CO5	H	H			L	M	L				M		H		L

F. Course Content

UNIT I INTRODUCTION TO DBMS 9

Purpose of Database System – Database Schema and Instances- Views of data – Database Languages - Database System Architecture – Database users and Administrator – Entity–Relationship model – E-R Diagrams - Introduction to relational databases –Structure of relational databases.

UNIT II RELATIONAL MODEL 9

Basics of the Relational Model- From E/R Diagrams to Relational Designs – Keys and Integrity Constraints - Relational Algebra – Relational Calculus-Tuple –Structured Query language(SQL) Basic and additional Operations – Nested Queries & Join Queries–Embedded SQL- Triggers - View Definitions and Modifications

UNIT III NORMALIZATION 9

Introduction and problem of data redundancy-Features of good Relational database design- Functional Dependencies - Normalization – First Normal Form, Second Normal Form and Third Normal Form –Advanced Normalization -Boyce/Codd Normal Form, Fourth Normal Form and Fifth Normal Form- Dependencies preservation-Case Studies of database system

UNIT IV TRANSACTION AND CONCURRENCY 9

Transaction Concepts – ACID Properties –Transactions and Schedules- Transaction States - Concurrent Execution- Serializability- Types of Failure-Recoverability -System Recovery – Media Recovery – Types of Locks-Two Phase locking – Deadlock- Detection, Recovery and Prevention.

UNIT V PHYSICAL STORAGE AND DATABASE CONCEPTS 9

Overview of Physical Storage Media – Magnetic Disks – RAID – Introduction to Distributed Databases and Client/Server Databases- Statistical Databases-

Multidimensional and Parallel databases- Spatial and multimedia databases- Mobile and web databases- Object Oriented Databases-XML Databases.

TOTAL : 45 Periods

G. Learning Resources

A. Text Books:

- 1) Abraham Silberschatz, Henry F. Korth and S. Sudharshan, "Database System Concepts", Sixth Edition, Tata McGraw Hill, 2011.
- 2) Hector Garcia-Molina, Jeff Ullman, and Jennifer Widom, "Database Systems: The Complete Book", Pearson Education, Second Edition, 2008.
- 3) RamezElmasri and Shamkant B. Navathe, "Fundamentals of Database Systems", Fifth Edition, Pearson Education, 2008.
- 4) C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.

B. References Books:

1. Raghu Ramakrishnan, "Database Management Systems", Third Edition, McGraw Hill, 2003.
2. S.K.Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006.
3. C. J. Date , "An Introduction to Database Systems" – 8th Edition, Addison Wesley, 2004.
4. S.K.Singh, "Database Systems Concepts, Design and Applications", First Edition, Pearson Education, 2006.

C. Online Resources:

1. http://cs.ulb.ac.be/public/_media/teaching/infoh303/dbmsnotes.pdf
2. <http://www.iitg.ernet.in/awekar/teaching/cs344fall11/lecturenotes/september%202012.pdf>
3. <http://sage.virtual-labs.ac.in/home/pub/1/>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS108	OPERATING SYSTEMS	3	0	0	3

Course Category: Program Core

A. Preamble :

In this course will be discussing about address spaces, system call interface, process/threads, inter process communication, deadlock, scheduling, main memory, virtual memory and file systems.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS110	{HYPERLINK \l "coa"}
2	1151CS105	{HYPERLINK \l "ss"}

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the operating system program, structures and operations with system calls	K2
CO2	Apply the process management concept for real time problems.	K3
CO3	Illustrate CPU scheduling algorithms and to handle the deadlock for the given situation.	K2
CO4	Explain the concepts of various memory management techniques.	K2
CO5	Summarize the storage concepts of disk and file.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	M											L	L
CO2	L	H	M	M	M		L	M	L		L	M	M	H	H
CO3	L	H	M	M	L				L				M	H	H
CO4	L	M	M	M	L			M				L	M	M	M
CO5	L	M	M	L		L						L		M	M

H- High; M-Medium; L-Low

F. Course Content:**UNIT I OPERATING SYSTEMS OVERVIEW L – 9**

Operating system overview: Objectives – functions - Computer System Organization- Operating System Structure - Operating System Operations- System Calls, System Programs.

UNIT II PROCESS MANAGEMENT L – 9

Processes: Process Concept - Process Scheduling - Operations on Processes – Inter process Communication. Process Synchronization: The Critical-Section Problem - Semaphores - Classic Problems of Synchronization – Monitors. Case Study: Windows 10 operating system

UNIT III SCHEDULING AND DEADLOCK MANAGEMENT

L – 9

CPU Scheduling: Scheduling Criteria - Scheduling Algorithms. Deadlocks: Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Case Study: MAC operating system

UNIT IV STORAGE MANAGEMENT L – 9

Main Memory: Swapping - Contiguous Memory Allocation, Segmentation, Paging. Virtual Memory: Demand Paging - Page Replacement - Allocation of Frames - Thrashing. Case Study: Android operating system

UNIT V STORAGE STRUCTURE

L – 9

Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management. File-System Interface: File Concepts, Directory Structure - File Sharing – Protection. File System. Case Study: Linux operating system

TOTAL : 45 Periods

G. Learning Resources

i. Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
2. Richard Petersen, "Linux: The Complete Reference", 6th Edition, Tata McGraw-Hill, 2008.

ii .Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall, Wesley, 2014.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.
3. Harvey M. Deitel, "Operating Systems", 7th Edition, Prentice Hall, 2003.
4. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", 2nd Edition, Tata McGraw-Hill Education, 2007.
5. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education", 1996.

iii. Online Resources:

1. {HYPERLINK "http://www.tutorialspoint.com/operating_system/"}
2. http://www.mu.ac.in/myweb_test/MCA%20study%20material/OS%20-%20PDF.pdf
3. <http://codex.cs.yale.edu/avi/os-book/OS8/os8c/slides-dir/PDF-dir/ch2.pdf>
{HYPERLINK "<http://www.freebookcentre.net/CompuScience/Free-Operating-Systems-Books-Download.html>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS109	THEORY OF COMPUTATION	3	0	0	3

Course Category: Program Core

A. Preamble:

This Course helps the learners to know the models of computation, along with their variants in the context of formal languages and their recognizers. This can be applied in designing compilers and pattern recognition system.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS115	{HYPERLINK \l "cd"}

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Design a finite automaton to recognize a given regular language.	K3
CO2	Build a Simplified Context Free Grammar for any language.	K3
CO3	Design a Pushdown automata model for context free grammar and vice versa.	K3
CO4	Develop a Computational model using Turing machine for the given problem.	K3
CO5	Examine the Unsolvable and Complexity for the given problems.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O1	PS O2	PS O3
CO1	H	H	H	H		L						H	H	M	H
CO2	H	H	H	H		L						L	H	M	H
CO3	H	H	H	H	M	L						L	H	M	H
CO4	H	H	M	H	M	L						L	H	M	H
CO5	H	H	L	M	M							L	M		H

H- High; M-Medium; L-Low

F. Course Content:

UNIT I FINITE AUTOMATA

L – 9

Introduction- Finite Automaton – DFA & NDFA – Finite Automaton with ϵ - moves – Equivalence of NFA and DFA – Equivalence of NDFA's with and without ϵ -moves – Regular Languages- Regular Expression –Equivalence of finite Automaton and regular expressions

UNIT II GRAMMARS

L – 9

Introduction- Types of Grammar - Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG– Greiback Normal form –Chomsky normal form

UNIT III PUSHDOWN AUTOMATA

L – 9

Pushdown Automata- Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL –pumping lemma

UNIT IV TURING MACHINES

L – 9

Definitions of Turing machines – Models – Computable languages and functions – Techniques for Turing machine construction – Multi head and Multi tape Turing Machines - The Halting problem – Partial Solvability - Chomskian hierarchy of languages.

UNIT V UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS L – 9

Unsolvable Problems and Computable Functions – Primitive recursive functions – Recursive and recursively enumerable languages – Universal Turing machine P and NP completeness - Polynomial time reductions.

TOTAL: 45 Periods

G. Learning Resources:

i. Text Books

1. John E Hopcraft, Rajeev Motwani, Jeffrey D Ullman, "Introduction to Automata Theory, Languages and Computation", PEA, Second Edition, 2001
2. Michael Sipser. Introduction to the Theory of Computation, Second Edition, Cenage Learning, India

ii. Reference Books:

1. Green Law, Hoover, "Fundamentals of the Theory of Computation – Principles and practice", Morgan & Kauffman Publishers, 1998
2. Daniel I.A. Cohen "Introduction to Computer Theory" Wiley-India, ISBN: 978-81-265-1334-5
3. E V Krishnamurthy, "Introduction to Theory of Computer Science", EWP Second 2nd Ed.
4. K.L.P Mishra, N. Chandrasekaran, "Theory of Computer Science (Automata, Languages and Computation)", Prentice Hall India, 2nd Edition
5. Daniel I.A. Cohen, "Introduction to Automata Theory Languages and Computations", Pearson Education Asia, Second Edition.

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS110	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3

Course Category: Program Core

A. Preamble :

This course provides the basics of organizational and architectural issues of a digital computer, analyze performance issues in processor and memory design of a digital computer. It also analyses various data transfer techniques in digital and performance improvement using instruction level parallelism.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS104	{HYPERLINK \l "de"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS108	Operating Systems

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Identify the basic structure and functional units of a digital computer.	K2
CO2	Familiarize with arithmetic algorithms and procedure for implementing them in hardware.	K2
CO3	Design a pipeline for consistent execution of instructions with minimum hazards.	K3
CO4	Understand parallel organization's as advanced computer architectures and the working principles of multiprocessor.	K2
CO5	Identify performance issues in processor and memory design of a digital computer.	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M										M	L	M
CO2	H	M	M	L										M	M
CO3	H	H	H	M	L			L	L			L	L	L	L
CO4	H	M	M		L			L	L			L	M		
CO5	H	M	M					L	L			L	M		

H- Strong; M-Medium; L-Low

F. Course Content:

9

UNIT I INTRODUCTION

Eight ideas – Components of a computer system – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions –Addressing and addressing modes.

UNIT II : ARITHMETIC OPERATIONS

8

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations .

UNIT III : PROCESSOR AND CONTROL UNIT

10

Basic MIPS implementation – Building datapath –Pipelining – Pipelined datapath and control – Handling Data hazards & Control hazards – Exceptions.

UNIT IV: PARALLELISM

9

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors

UNIT V: MEMORY AND I/O SYSTEMS

9

Memory hierarchy - Memory technologies – Cache basics –Cache Memory Mapping Techniques– Measuring and improving cache performance - Virtual memory, TLBs ,Page Replacement Techniques- Input/output system- DMA and interrupts, I/O processors.

TOTAL : 45 Periods

G. Learning Resources

i.Text Books:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Fourth Edition, Elsevier, 2011.

2. Carl Hamacher, ZvonkoVranesic and SafwatZaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.

ii. Reference Books:

- 1 M.Morris Mano, "Computer System Architecture"- Third Edition, Pearson Education, 2007.
- 2.BehroozParhami, "Computer Architecture", Oxford University Press, 2007.
3. V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.
- 4,William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.
5. John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 1998.

iii. Online Resources:

1. [www.ComputerArchitecture Home Page](http://www.ComputerArchitectureHome Page)
2. ACM Special Interest Group on Computer
3. IEEE Technical Committee on Computer Architecture
williamstallings.com/ComputerOrganization/COA8e-Instructor/

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS111	COMPUTER NETWORKS	3	0	0	3

Course Category: Program Core

A. Preamble :

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the basic fundamentals of networks for data communication and transmission.	K2
CO2	Describe the various techniques for both analog and digital data communication and its standards.	K2
CO3	Apply the various error detection and correction techniques to solve collisions problems.	K3
CO4	Identify and classify the various network layer protocols to apply in various networks.	K2
CO5	Discuss the various protocols and techniques used in transport layer and application layer.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	L				L		L			H	L		
CO2	H	H	L				L		L			L	L	L	M
CO3	H	H	L	L			L		L			M	M	L	M
CO4	H	H	L	L			L	L	L			M	L	L	M
CO5	H	H	L	L			L	L	L			M	L	L	M

H- High; M-Medium; L-Low

F. Course Content :

UNIT I Introduction 9

Data Communication: Data Communication system components - Network Models - OSI Model - TCP/IP Protocol Suite - Addressing - Data and Signals - Analog And Digital - Transmission Impairment - Data rate and Channel capacity – Performance.

UNIT II Physical Layer 9

Digital Transmission - Digital-To-Digital Conversion - Analog Transmission - Digital-To-Analog Conversion - Transmission Media - Guided Media - Unguided Media: Wireless - Wired LANs: Ethernet - Token ring - Connecting Devices – Switching techniques.

UNIT III Data Link Layer 9

Link Layer: Types of errors –Error detection- VRC, LRC, CRC techniques - Data Forward and backward error correction - Hamming code. Flow control: stop and wait-sliding window protocol, Error control: Stop and wait ARQ- Go-Back-N ARQ- Selective Repeat ARQ Protocols- Asynchronous and Synchronous Protocol - HDLC frames.

UNIT IV Network layer 9

Logical Addressing - IPv4 Addresses - IPv6 Addresses - Address Mapping – ARP – RARP, BOOTP, and DHCP – ICMP – Unicast Routing Protocols - Intra- and Interdomain Routing - Distance Vector Routing - Link State Routing.

UNIT V	Transport Layer and Application Layer	9
Process-to-Process Delivery:	UDP – TCP - Congestion Control - Quality of Service - Techniques to Improve QoS - Application layer protocols: REMOTE LOGGING - TELNET -ELECTRONIC MAIL – DNS – SMTP – FTP - HTTP.	
TOTAL: 45 Periods		

G. Learning Resources

i.Text Books :

1. BehrouzForouzan, "Data Communications and Networking", Tata McGraw Hill, 5th Edition, 2015.
2. Stallings, "Data and Computer Communications", PHI, 10th Edition, 2015.

ii.Reference:

1. William Schewber, "Data Communication", McGraw Hill, 1987.
2. Tanenbaum , "Computer Networks", PHI, 5rd Edition, 2011

iii. Online Resources

1. {HYPERLINK "<http://www.cse.iitk.ac.in/users/dheeraj/cs425/>"}
2. {HYPERLINK "http://www.tcpipguide.com/free/t_OSIReferenceModelLayers.htm"}
3. {HYPERLINK "<http://iit.qau.edu.pk/books/Data%20Communications%20and%20Networking%20By%20Behrouz%20A.Forouzan.pdf>"}
4. {HYPERLINK "<http://www.networkdictionary.com/protocols/osimodel.php>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS112	OBJECT ORIENTED SOFTWARE ENGINEERING	3	0	0	3

Course Category: Program Core

A. Preamble:

Software engineers are those who contribute by direct participation or by teaching, to the analysis, specification, design, development, certification, maintenance, and testing of software systems

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS107	{HYPERLINK \l "dbms"}

C. Related Courses:

Sl No	Course Code	Course Name
1	1151CS201	{HYPERLINK \l "mad"}

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Summarize about software development process models	K2
CO2	Estimate the software project based on project planning and its constraints.	K2
CO3	Construct and Sketch the UML diagrams for given scenario.	K3
CO4	Explain the software design heuristics for quality improvement.	K2
CO5	Discuss on different types of testing strategies.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H		M			M			M	L		H		M	
CO2	H	L	M			M		M	M	M	H	M	L	M	
CO3	H	M	H	M	M	M		M	M		M	M		H	L
CO4	H	M	H	M		M		M	M	M	M	M		H	
CO5	H		M	M	L	M		M	M	M	H	M		H	L

F. Course Content:**UNIT- I Introduction**

9

Introduction to Software Engineering - Software Development process models – Agile Development - Project & Process - Project management - Process & Project metrics - Object Oriented concepts, Principles & Methodologies.

UNIT- II Planning & Scheduling

9

Software Requirements Specification, Software prototyping - Software project planning - Scope - Resources - Software Estimation - Empirical Estimation Models – Planning - Risk Management - Software Project Scheduling - Object Oriented Estimation & Scheduling.

UNIT -III Analysis

9

UML: Analysis Modeling - Data Modeling - Functional Modeling & Information Flow - Behavioral Modeling-Structured Analysis - Object Oriented Analysis - Domain Analysis-Object oriented Analysis process - Object Relationship Model - Object Behavior Model. Design modelling with UML.

UNIT -IV Design

9

Design Concepts & Principles - Design Process - Design Concepts - Modular Design - Design Effective Modularity - Introduction to Software Architecture - Data Design - Transform Mapping - Transaction Mapping - Object Oriented Design - System design process- Object design process - Design Patterns.

UNIT -V Implementation, Testing & Maintenance

9

Top - Down, Bottom-Up, object-oriented product Implementation & Integration. Software Testing Methods-White Box, Basis Path-Control Structure - Black Box - Unit Testing - Integration testing - Validation & System testing - Testing Tools – Software Maintenance & Reengineering.

TOTAL: 45 Periods

G. Learning Resources

i. Text Books:

1. Roger. S. Pressman and Bruce R. Maxim, "Software Engineering - A Practitioner's Approach", seventh Edition, McGraw Hill, 2015.
2. Ian Sommerville, "Software Engineering", eighth edition, Pearson Education, New Delhi, 2011.
3. Ali Bahrami, "Object Oriented Systems Development" 1st Edition, The McGraw-Hill Company, 1999.
4. Craig Larman, Applying UML and Patterns: An Introduction to Object-Oriented Analysis and Design and Iterative Development (3rd Edition), Pearson Education, 2008.

ii. Reference:

1. Fairley R, "Software Engineering Concepts", second edition, Tata McGraw Hill, New Delhi, 2003.
2. Jalote P, "An Integrated Approach to Software Engineering", third edition, Narosa Publishers, New Delhi, 2013.
3. Grady Booch, James Rumbaugh, Ivar Jacobson - "the Unified Modeling Language User Guide" - Addison Wesley, 1999.
4. Bill Barczewski, Richard D. Stutz, " Software Engineering Project Management", Wiley India Edition, IEEE computer society, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS113	COMPUTER GRAPHICS AND IMAGE PROCESSING	3	0	0	3

Course Category: Program Core

A. Preamble:

To introduce the necessary background, the basic algorithms, and the applications of computer graphics and image processing.

B. Pre-requisite

Sl. No	Course Code	Course Name
1	1150MA103	Engineering Mathematics 2
2.	1150CS201	Problem Solving using C

C. Link to Other courses

Sl. No	Course Code	Course Name
1	1152CS111	{HYPERLINK \l "MS"}
2	1152CS113	{HYPERLINK \l "CV"}

D. Course Outcomes

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the basics of computer graphics, design algorithms for 2D output primitives and learn 2D & 3D transformation	K2
CO2	Illustrate basics concepts of shading, illumination and surface detection algorithms	K2
CO3	Explain the abstractions of models for specifying complex objects and introduction to image processing.	K2
CO4	Summarize color models and image segmentation algorithms	K2
CO5	Summarize image restoration and Image classification algorithms.	K2

E. Correlation of COs with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L											M		
CO2	M	M											M		
CO3	M												L	M	L
CO4	M	L	M										L	M	M
CO5	M	L											L	M	M

H- Strong; M-Medium; L-Low

F. Course content

UNIT I REVIEW OF GRAPHICS FUNDAMENTALS

9

Basic raster graphical algorithm for 2D primitives, Line drawing algorithm, Circle drawing algorithm, Ellipse drawing algorithm, 2D and 3D transformations; Window, Viewport, Clipping algorithm, Bezier curve, b-spline curve, surfaces and Solid modeling.

UNIT II SHADING

9

Parallel projection-Perspective projection, Buffer algorithm, Scan line algorithm. Area subdivision and Ray tracing algorithms. Illumination mode, Specular reflection model, Shading models for curve surfaces, Recursive ray tracing, Texture mapping

UNIT III ADVANCE MODELLING AND IMAGE PROCESSING

9

Procedural Models, Fractal Models, Grammar based models, particle systems. Image – Introduction, Elements of visual perception, Steps in Image Processing Systems – Image Acquisition – Sampling and Quantization – Pixel Relationships

UNIT IV COLOR MODELS AND SEGMENTATION

9

Color Model- RGB- CMYK -HSV- Watersheds and minimum spanning trees
Deformable Methods – Intelligent scissors/ livewires, active contours; DP snakes

UNIT V IMAGE RECONSTRUCTION AND PATTERN ANALYSIS

9

Restoration, noise removal, clustering. K means, K-metoids, Mixture of gaussian, classification: discriminate function, supervised, un supervised, semi-supervised; classifiers: Bayes, KNN, ANN models.

TOTAL: 45 Periods

G. Learning materials

i. TEXT BOOKS

1. Hearn & Baker, "Computer Graphics C version", 2nd ed. Pearson Education, 2012.
2. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, Pearson Education, 2008.

ii. Reference Books

1. DaveShreiner, Graham Sellers, John M. Kessenich, Bill M. Licea-Kane , "OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3", 8th Edition, ARB working group.
2. Hearn and Baker, "Computer Graphics using open GL", 3rd edition, Pearson Education, 2009.
3. Rogers, "Procedural Element for Computer Graphics", 2nd ed, Tata McGraw Hill, 2001.

iii Web References

1. {HYPERLINK "http://www.cs.manchester.ac.uk/ugt/COMP27112/" \t "_blank"}
2. {HYPERLINK "http://www.slideshare.net/.../computer-graphics-image-processing-lecture-n." \t "_blank"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS114	DATA WAREHOUSING AND DATA MINING	3	0	0	3

Course Category: Program Core

A. Preamble:

To introduce the necessary background, the basic algorithms, and the applications of computer graphics and image processing.

B. Pre-requisite

Sl. No	Course Code	Course Name
1	1151CS107	{HYPERLINK \l "dbms"}

C. Link to Other courses

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objective

Students undergoing this course are expected to

- Introduction to computer graphics leading to the ability to understand contemporary terminology, progress, issues, and trends.
- Explain the thorough introduction to computer graphics techniques, focusing on Modeling.
- Basics of the Image Processing, Segmentation and Restoration

E. Course Outcomes

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain and identify the subject areas for which a data warehouse is to be built.	K2
CO2	Design Multidimensional data model for data warehouse and analyze the market needs by applying the suitable OLAP operations.	K3

CO3	Explain the concept of Data mining system and apply the various preprocessing techniques on large dataset.	K2
CO4	Apply Association rule mining, classification and clustering techniques to discover various mining patterns.	K3
CO5	Apply clustering techniques in various data mining applications	K3

F. Correlation of COs with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	M	H										M	
CO2	H	H	M	H		M		M	M	M		L		M	M
CO3	H	H	H	M					L			M	M	M	L
CO4	H	M	H	M		M		M	L				H	H	M
CO5	H	L	H	L	M	M		M				M	H	H	M

H- Strong; M-Medium; L-Low

G. Course content

UNIT I DATA WAREHOUSING

L-10

Introduction to Data warehousing – Evolution of Decision Support systems – Modeling a Data Warehouse – Granularity in the Data Warehouse - Building a Data Warehouse – Data Warehouse Components –Data Warehouse Architecture - Metadata.

UNIT II BUSINESS ANALYSIS

L-9

Mapping the Data Warehouse to a Multiprocessor Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –. Reporting and Query tools and Applications –Online Analytical Processing (OLAP) – Need – Multidimensional Data Model – OLAP Guidelines – Multidimensional versus Multirelational OLAP – Categorization of OLAP Tools.

UNIT III DATA MINING

L-8

Introduction to Data mining and Knowledge Discovery – Data – Databases – Data
{PAGE }

Mining Functionalities – Steps in Data Mining Process, Architecture of Typical Data Mining systems – Classification of Data Mining Systems – Data Mining Task Primitives – Overview of Data mining Techniques – Issues –Data Preprocessing.

UNIT IV ASSOCIATION RULE MINING AND CLASSIFICATION L-10

Mining Association Rules in Large Databases – Mining Various Kinds of Association Rules – Correlation Analysis –Constraint Based Association Mining – Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction.

UNIT V CLUSTERING, APPLICATIONS AND TRENDS IN DATA MINING

L-8

Cluster Analysis - Types of Data – Categorization of Major Clustering Methods - K-means – Partitioning Methods – Hierarchical Methods - Outlier Analysis – Data Mining Applications – Social Impacts of Data Mining – Mining WWW - Mining Text Database – Mining Spatial Databases - Case Studies (Simulation Tool).

TOTAL: 45 Hours

H. Learning Resource

i. Text Books

1. W.H. Inmon, "Building the Data Warehouse", John Wiley & Sons, Inc, 4th Edition, 2005.
2. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw – Hill Edition, Tenth Reprint 2007.
3. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques", Third Edition, Elsevier, 2012.

ii. Reference Books

1. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, "Introduction to Data Mining", Person Education, 2007.
2. K.P. Soman, Shyam Diwakar and V. Ajay ", Insight into Data mining Theory and Practice", Easter Economy Edition, Prentice Hall of India, 2006.
3. G. K. Gupta, "Introduction to Data Mining with Case Studies", Easter Economy Edition, Prentice Hall of India, 2006.
4. Daniel T.Larose, "Data Mining Methods and Models", Wile-Interscience, 2006.

iii Web References

1. www.slideshare.net/.../data-warehousing-and-data-mining-presentation
2. www.wright.edu/~arijit.sengupta/mis710/notes/lect6a-datamining.ppt
3. <https://www.cse.iitb.ac.in/infolab/Data/Talks/krithi-talk-impact.ppt>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS115	COMPILER DESIGN	3	0	0	3

Course Category: Program Core

A. Preamble:

This Course describes the theory and practice of compilation, in particular, the lexical analysis, parsing and code generation and optimization phases of compilation, and design a compiler for a concise programming language.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS109	Theory of Computation

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level(Based on revised Bloom's Taxonomy)
CO1	Understand the major phases of compilation and to understand the knowledge of Lex tool & YAAC tool	K2
CO2	Develop the parsers and experiment the knowledge of different parsers design without automated tools	K3
CO3	Construct the intermediate code representations and generation	K3
CO4	Convert source code for a novel language into machine code for a novel computer	K3
CO5	Apply for various optimization techniques for dataflow analysis	K3

E. Correlation of COs with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	M	M		M		L		L				H	M	M
CO2	L	H	M	M	H				M				H	M	
CO3	L	H	H		M								L	M	
CO4	H	H	L		H		L						M	L	L
CO5	H	H	H		M				M				M	H	L

H- High; M-Medium; L-Low

F. Course Content:

UNIT I Introduction to Compilers

9

Compilers, Analysis of the Source Program, The Phases of a Compiler, Cousins of the Compiler, The Grouping of Phases, Compiler-Construction Tools.

LEXICAL ANALYSIS: Need and role of lexical analyser-Lexical errors, Input Buffering - Specification of Tokens, Recognition of Tokens, Design of a Lexical Analyzer Generator

UNIT II Syntax Analysis

9

Need and role of the parser- Context Free Grammars-Top Down parsing - Recursive Descent Parser - Predictive Parser - LL (1) Parser -Shift Reduce Parser - LR Parser - LR (0) item - Construction of SLR Parsing table -Introduction to LALR Parser, YACC- Design of a syntax analyser for a sample language

UNIT III Intermediate Code Generation

9

Intermediate languages – Declarations – Assignment Statements – Boolean Expressions – Case Statements – Back patching – Procedure calls.

UNIT IV Code Generation

9

Issues in the design of code generator – The target machine – Runtime Storage management – Basic Blocks and Flow Graphs – Next-use Information – A simple Code generator – DAG representation of Basic Blocks

UNIT V Code Optimization and Run Time Environments**9**

Introduction– Principal Sources of Optimization – Peephole Optimization- Optimization of basic Blocks – Introduction to Global Data Flow Analysis – Runtime Environments – Source Language issues – Storage Organization – Storage Allocation strategies – Access to non-local names – Parameter Passing.

TOTAL: 45 Periods**G. Learning Resources****i.Text Books:**

1. Alfred Aho, Ravi Sethi, Jeffrey D Ullman, "Compilers Principles, Techniques and Tools", Pearson Education Asia, 2003.

ii. Reference Books:

1. Allen I. Holub "Compiler Design in C", Prentice Hall of India, 2003.
2. C. N. Fischer and R. J. LeBlanc, "Crafting a compiler with C", Benjamin Cummings, 2003.
3. J.P. Bennet, "Introduction to Compiler Techniques", Second Edition, Tata McGraw-Hill, 2003.
4. Henk Alblas and Albert Nymeyer, "Practice and Principles of Compiler Building with C", PHI, 2001.
5. Kenneth C. Louden, "Compiler Construction: Principles and Practice", Thompson Learning, 2003

iii. Online Recourses:

1. http://www.tutorialspoint.com/compiler_design/
2. <http://nptel.ac.in/courses/106104123/Compiler%20DesignQuestions.pdf>
3. {HYPERLINK "http://www.vssut.ac.in/lecture_notes/lecture1422914957.pdf"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS116	MICROPROCESSORS AND MICROCONTROLLERS	3	0	0	3

Course Category: Program Core

A. Preamble :

The Purpose of the course is to provide students with the Knowledge of Microprocessors and Microcontroller. To solve real world problems in an efficient manner, this course also emphasis on architecture, Programming and system design used in various day to day gadgets.

B. Pre-requisite :

Sl. No	Course Code	Course Name
1	1151CS104	{HYPERLINK "file:///C:/\Users\Administrator\Desktop\SoC\VTU%20R15%202017%20version%20(1).docx" \l "de"}

C. Link to Other Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Develop an ALP in 8085 microprocessor using the internal organization for the given specification	K3
CO2	Describe the architecture and functional block of 8051 microcontroller	K2
CO3	Develop an embedded C and ALP in 8051 microcontroller using the internal functional blocks for the given specification	K3

CO4	Explain various peripherals devices such as 8255, 8279, 8251, 8253,8259 and 8237	K2
CO5	Explain microcontroller application and basic architecture of PIC,ARM and ATMEGA processors.	K2

E. Correlation of COs with Programme outcomes:

H- High; M-Medium; L-Low

F. Course Content :

UNIT I 8085 CPU L-9

8085 Architecture – Pin diagram-Memory interfacing – I/O interfacing- Timing Diagram- Instruction Set- Addressing modes – Assembly language programming-comparison of 8 bit (8085) and 16 bit (8086)processors.

UNIT II 8051 ARCHITECTURE L- 9

Architecture – memory organization -I/O ports and circuits-Timers - Interrupts –serial communication - Interfacing of External memory-Interfacing LCD & Keyboard-RTC.

UNIT III 8051 PROGRAMMING I-9

Addressing modes -instruction set -Assembly language programming and C Programming-Timer Counter Programming – Serial Communication Programming-Interrupt Programming.

UNIT IV PERIPHERAL DEVICES I - 10

Parallel peripheral Interface (8255) - Timer / Counter (8253) - Keyboard and Display Controller (8279) - USART (8251) - Interrupt Controller (8259)- DMA Controller (8237).

UNIT VMICROCONTROLLER APPLICATIONS & ADVANCED PROCESSOR L -8

Temperature control system- Motor speed control system – Traffic light System – Elevator system-Data Acquisitions system - Introduction to architecture of PIC, ARM, ATMEGA processors

Total: 45 Periods

G. Learning Resources:

i.Text Books:

1. Ramesh S Gaonkar, Microprocessor Architecture, Programming and application with 8085, 6th Edition, Penram International Publishing .(UNIT 1&4)
2. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D McKinlay, The 8051 microcontroller and embedded systems using assembly and C, second edition Pearson education Asia.(UNIT 2 & 3)
3. Mohamed Rafiquzzaman, Microprocessor and Microcomputer based system design, second edition, CRC press(UNIT 5)

ii.Reference:

1. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, third Edition, Penram International Publishers.
2. A.K Ray & K.M. Burchandi, Advanced Microprocessor and peripherals Architectures, Programming and interfacing ”, second edition, Tata McGraw-Hill

iii.Online resources

1. <https://www.youtube.com/watch?v=liRPtvj7bFU&list=PL0E131A78ABFBFDD0>
2. <https://www.youtube.com/watch?v=95uGOJ1Ud2c&list=PLJGA4olwzpArvcDWULcRuMn2495g0n8j>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS118	MICROPROCESSORS AND CONTROLLERS	3	0	0	3

Course Category: Program Core

H. Preamble:

The Purpose of the course is to provide students with the Knowledge of Microprocessors and Microcontroller. To solve real world problems in an efficient manner, this course also emphasis on architecture, Programming and system design used in various day to day gadgets.

I. Pre-requisite:

Sl. No	Course Code	Course Name
1	1151CS110	Computer Organization and architecture

J. Link to Other Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

K. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Develop an ALP in 8086 microprocessor using the internal organization for the given specification	K3
CO2	Understand the bus architecture of 8086 microcontroller and other advanced processors	K2
CO3	Describe the architecture and functional block of 8051 microcontroller	K2
CO4	Illustrate the various peripherals devices such as 8255, 8279, 8251, 8253, 8259 and 8237	K2
CO5	Understand the microcontroller application and basic architecture of PIC, ARM and ATMEGA processors.	K2

L. Correlation of COs with POs and PSOs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3
CO 1	M	H	H	M				L					L	M	M
CO 2	L	L	H						M					L	
CO 3	L	M	L	M	L			L				H	L	M	M
CO 4	M		L	L											
CO 5	L	L	M				L					M			

H- High; M-Medium; L-Low

F. Course Content:

UNIT I THE 8086 MICROPROCESSOR 9

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – Byte and String Manipulation.

UNIT II 8086 SYSTEM BUS STRUCTURE 9

8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming – Introduction to Multiprogramming – System Bus Structure – Multiprocessor configurations – Coprocessor, closely coupled and loosely Coupled configurations – Introduction to Pentium family processors.

UNIT III 8051 ARCHITECTURE 9

Architecture – memory organization –I/O ports and circuits-Timers - Interrupts –serial communication – Addressing modes –Instruction set.

UNIT IV PERIPHERAL DEVICES 10

Parallel peripheral Interface (8255) - Timer / Counter (8253) - Keyboard and Display Controller (8279) - USART (8251) - Interrupt Controller (8259)- DMA Controller (8237).

UNIT VMICROCONTROLLER APPLICATIONS & ADVANCED PROCESSOR 8
Temperature control system- Motor speed control system – Traffic light System –
Elevator system - Introduction to architecture of PIC, ARM, ATMEGA processors
Total: 45 Periods

G. Learning Resources:

i.Text Books:

1. Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family -Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007.2.
2. Muhammad Ali Mazidi, Janice GillispieMazidi and Rolin D McKinlay, The 8051 microcontroller and embedded systems using assembly and C, second edition Pearson education Asia. (UNIT 2 & 3)
3. Fredrick J. Hill, Gerald R. Peterson, " Digital logic and microprocessors", Wiley publication

ii.Reference:

1. Kenneth J Ayala, The 8051 Microcontroller Architecture Programming and Application, third Edition, Penram International Publishers.
2. A.K Ray & K.M. Burchandi, Advanced Microprocessor and peripherals Architectures, Programming and interfacing ", second edition, Tata McGraw-Hill

iii.Online resources

1. <https://www.youtube.com/watch?v=liRPtvj7bFU&list=PL0E131A78ABFBFDD0>
2. <https://www.youtube.com/watch?v=95uGOJ1Ud2c&list=PLJGA4olwzpArvcDWULcRuMn2495g0n8j>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS201	MOBILE APPLICATION DEVELOPMENT	3	0	2	4

Course Category: Program Core

A. Preamble:

In this modern era almost, every hand has a handheld device. Each handheld device has the computing capability to meet half the needs of user such as banking, browsing, education and emergency etc. It is a must for a computer engineer to have some basic knowledge about the handheld devices platform and its supporting software development. This course will give adequate knowledge in developing a mobile application for different such as Android, iOS, Windows.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS103	{HYPERLINK \l "jp"}
2	1151CS117	Java Programming
3	1151CS112	{HYPERLINK \l "oose"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain Android Architecture and various mobile platforms	K2
CO2	Develop Android application with basic building blocks	K3

CO3	Familiarize in the Graphics and Multimedia used for Android application development												K2		
CO4	Test the developed app and publishing for users												K3		
CO5	Explain the development of app for iOS and Windows platform												K2		

E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	M			M	M	M				M	M	M		
CO2	M	M	M		H			M	M			L		M	M
CO3	H	H	H		H			M			M			M	
CO4	H	M	M		H			M	M	M	M	L		M	M
CO5	M	M	M		H										

H- High; M-Medium; L-Low

F. Course Content:

UNIT 1: GETTING STARTED WITH MOBILITY L-9

Mobility landscape- Mobile platform- Mobile apps development, Overview of Android platform-setting up the mobile app development environment along with an emulator-case study on Mobile app development

UNIT II: BUILDING BLOCKS OF MOBILE APPS L-9

App user interface designing – mobile UI resources (Layout, UI elements, Drawable, Menu), Activity- states and life cycle, interaction amongst activities-App functionality beyond user interface - Threads, Async task, Services – states and lifecycle, Notifications, Broadcast receivers, Telephony and SMS

UNIT III: SPRUCING UP MOBILE APPS L-9

Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record location awareness- native hardware access (sensors such as accelerometer and gyroscope)

UNIT IV: TESTING MOBILE APPS and PUBLISHING L-9

Debugging mobile apps- App Test procedure - test automation of mobile apps- JUnit for Android - Versioning, signing and packaging mobile apps, distributing apps on mobile marketplace

UNIT V: CROSS COMPILER APP DEVELOPMENT	L-9
Introduction cross platform development -XAMARIN – XMAL – XMARIN FORMS – XAMARIN. IOS – XAMARIN.WINDOWS	

Lab Experiment:	L-15
1. Setting up android and android emulator 2. Creating UI element – Layout 3. Creating UI element – Button 4. Creating UI element - Menu 5. Demonstrating Thread 6. Demonstrating Services 7. Creating Animation view and canvas 8. Listing the sensors used in mobile phone 9. Creating .apk file and publishing 10. Creating simple application using XAMARIN	Total :75

G. Learning Resources

i. Text Books

1. Anubhav Pradhan, Anil V Deshpande "Composing Mobile Apps Learn | Explore | Apply using Andriod", Wiley Publications 1st Edition 2014.
2. Xamarin Studio for Android Programming: A C# Cookbook by Mathieu Nayrolles

ii. Reference Books

1. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.
2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012
3. Xamarin 4.x "Cross-Platform Application Development", by Jonathan Peppers

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS202	INTERNET PROGRAMMING	2	0	2	3

Course Category: Program Core

A. Preamble:

This course Internet Programming provides an introduction and Basic Concepts of Server-Side Programming and Designing of Static and Dynamic WebPages.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS103	{HYPERLINK \l "jp"}
2	1151CS117	Java Programming

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Demonstrate web applications using Hypertext Markup Language, Cascading style sheets and Java Database Connectivity.	K2
CO2	Explain about the java networking technologies and working of struts framework.	K2
CO3	Develop applications using hibernate framework and Hypertext Markup Language Protocols.	K3
CO4	Design web applications in PHP (Hypertext Preprocessing) and to present data in XMLformat.	K3
CO5	Illustrate Rich Internet Application using AJAX and web services.	K2

E. Correlation of COs with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	M	M					L					L	H	L
CO2	M	L	L	L	L								L	M	L
CO3	M	H	H	M	L			L	H	L	M	M	L	H	L
CO4	M	H	H	L				L	M			M	L	M	L
CO5	M	M	M	L	L	L	L	H			M	M	L	H	L

H- Strong; M-Medium; L-Low

F. Course Content:

UNIT I WEBSITES BASICS, HTML 5, CSS 3

9

Basics-RIA Rich Internet Applications Internet technologies Overview –Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0, XHTML, CSS 3- TCP and Datagram Sockets – Remote Method Invocation - Servlets, Java Server Pages. – JDBC Java Beans – Enterprise Java Beans.

UNIT II NAMING SERVICES AND STRUTS

9

Java Security – Native Methods – Java Virtual Machine - Naming Services – Java Mail – Java Messaging Services – Transactions- Introduction to struts Frame work.

UNIT III HIBERNATE, HTML AND PROTOCOLS

9

Introduction to hibernate – Hibernate, HQL – J2EE (struts) and hibernate –Hibernate and Aspect – Birth Reporting Tool. Introduction – Network concepts - Web concepts – Internet addresses – URL – Retrieving Data with URL - CGI – Introduction to HTML – HTML protocols – HTTP, SMTP, POP3, MIME, IMAP – Forms – Events.

UNIT IV PHP and XML 8

9

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in Functions-Connecting to Database – Using Cookies-Regular Expressions; XML: Basic XML- Document Type DefinitionXML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

UNIT V INTRODUCTION TO AJAX and WEB SERVICES

9

Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application – SOAP

TOTAL: 45 periods

G. Learning Resources:

i. Text Book

1. Deitel&Deitel, Goldberg, "Internet and world wide web – How to Program", Pearson Education Asia, 2011.

ii. Reference Books

1. Chris Bates, Web Programming – Building Intranet Applications, 3 rd. Edition, Wiley Publications, 2009.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2011.
3. UttamK. Roy, "Web Technologies", Oxford University Press, 2011.

iii. Online Resources

1. Eric Ladd, Jim O' Donnel, "Using HTML 4, XML and JAVA", Prentice Hall of India – QUE, 1999.
2. PHP &MYSQL TimConverse, Joyce Park, Alark Morgan.
3. PHP for Beginners VikramVaswani, Tata McGraw-Hill
4. Ajax in Action, Dreamtech press
5. WWW. W3schools.com

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS301	DATA STRUCTURES LAB	0	0	2	1

Course Category: Program Core

A. Preamble :

This course provides rich set of problems covering the basic algorithms as well as numerous computing problems demonstrating the applicability of various data structures and related algorithms which is implemented in C .

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Students undergoing this course are able to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
1	Identify, Implement and execute programs to solve problems using data structures such as arrays, linked lists, stacks, queues, trees, graphs and search trees.	S3
2	Apply recursive programming Skills to Demonstrate algorithms.	S3
3	Write and execute programs to implement various sorting and searching methods.	S3

E. Correlation with Programme Outcomes :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1.	H	H	H	L		M		M	H		M	M	H	L	M
CO2.	H	H	H	L				M	M			M	M	L	
CO3	H	H	H	M		M	M	M	M		H	M	H	M	M

F. Course Content

LIST OF EXPERIMENTS:

CYCLE I

S. No	Experiment name
1	Implementation of Queue using Array
2	Implementation of singly linked list
3	Infix to postfix conversion
4	Implementation of Binary Search Tree

CYCLE II

5	Implementation of Breadth First Search
6	Implementation of Depth First Search
7	Insertion sort and Bubble sort
8	Heap sort
9	Quick sort
10	Linear search and Binary search

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Stand alone desktops with C/C++ compiler 30 Nos.

(or)

Server with C/C++ compiler supporting 30 terminals or more.

G. Learning Resources

i. Text Book

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2007.

ii. Reference Books

1. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition Reprint 2003.
2. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2005.
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structure", Computer Science Press, 1995.

iii. Online Resources

1. <http://www.academictutorials.com/data-structure/>
2. <http://www.c4learn.com/data-structure/introduction-to-linked-list-c-programming/>
3. <http://randu.org/tutorials/c/ads.php>
4. https://faculty.washington.edu/jstraub/dsa/Master_2_7a.pdf
5. <http://www.zentut.com/c-tutorial/>
6. <http://www.studytonight.com/data-structures/introduction-to-data-structures>

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS302	JAVA PROGRAMMING LAB	0	0	2	1

Course Category: Program Core

A. Preamble:

Most of the software need to develop runs in cross platform. Java is the one of the pioneer software development tools developed used for cross platform development software. From the system towards the handheld devices all place Java become one of the most dominant software. This course provides a basic concept about Object Oriented Programming, Database connectivity, Networking and finally provides programming skills in java. After successful completion of this course learners can able to develop software modules for real world problem.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Students undergoing this course are able to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
1	Write a java program using classes, methods, Objects and control structures.	S3
2	Implement inheritance, interfaces and packages in various applications.	S3
3	Develop simple applications for handling pre-defined and user defined exceptions.	S3

4	Develop simple applications using GUIs and event driven programming.	S3
5	Construct an application using JDBC.	S3

E. Correlation with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	L		M		L			H	L		M		L	L	L
CO2	L		M		L			H	L		M		L	M	L
CO3	L		M		L			H	L		M		L	M	L
CO4	L	H	M		H			H	M	M	M		L	M	L
CO5	L	H	H	M	H	L	L	H	M	M	H	M	L	H	L

F. Course Content

-LIST OF EXPERIMENTS:

1. Simple Java applications
 - for understanding reference to an instance of a class (object), methods
 - Handling Strings in Java
2. Constructors
 - Implement constructor overloading.
3. Inheritance
 - To Implement Method Overloading and Method Overriding.
4. Package creation.
 - Developing user defined packages in Java
5. Interfaces
 - Developing user-defined interfaces and implementation
 - Use of predefined interfaces
6. Threading
 - Creation of thread in Java applications
 - Multithreading
7. Exception Handling Mechanism in Java
 - Handling pre-defined exceptions
 - Handling user-defined exceptions
8. AWT-To Create Different Layout Managers.
9. JDBC-To connect Oracle/MS Access for Table creation and Data Manipulation.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Standalone desktops with JDK 30 Nos.

G. Learning Resources

i. Text Books

- 1.E. Balaguruswamy, Programming in java, Fourth Edition, TMH,2010.
2. Patri Naughton, Herbert Schildt, The Complete Reference “Java 2 ”, Ninth edition Tata McGraw Hills ,2014.

ii. Reference Books

1. H.M. Deitel and P.J. Deitel– **“Java How to Program”** Pearson Prentice Hall 6th Edition, 2011.
2. Sachi Malhotra,” Programming in JAVA”, Oxford University Press, 2011.
3. Maydene Fisher, Jonathan Ellis, Jonathan Bruce,” *JDBC Database access with java*” Addison-Wesley, Third Edition 2003
4. Bruce Eckel – **“Thinking in Java”** Pearson Prentice Hall Third Edition-2006

iii. Online Resources

1. docs.oracle.com/javaee/6/tutorial/doc/girgm.html
2. www.webreference.com/programming/java.html
3. {HYPERLINK "<http://www.apl.jhu.edu/~hall/java/Documentation.html>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS303	DATABASE MANAGEMENT SYSTEM LAB	0	0	2	1

Course Category: Program Core

A. Preamble:

This course starts from developing a simple query to notification and security level issues that involve views trigger events and reports. Also students are encouraged to do a Minor Project with the help of Visual basic and SQL on their own that tunes out them in finding various procedures that suits the need of the application.

B. Pre-requisite:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes

At the end of the course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Infer database language commands to create simple database	S3
CO2	Analyze the database using queries to retrieve records	S3
CO3	Applying PL/SQL for processing database	S3
CO4	Analyze front end tools to design forms, reports and menus	S3
C05	Develop solutions using database concepts for real time requirements.	S3

E. Correlation of COs with POs and PSOs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M				L			M					L	L	
CO2	M	H		M	M			M					L	L	
CO3	M				M			M	M				L	L	
CO4	M	M	L	M	M			M	M		M	M	L	H	L
CO5	M	H	L	M	H			H	H		H	M	L	H	L

F. LIST OF EXPERIMENTS

Cycle-1

1. DDL Commands – Table Creation, Altering the table structures, truncating a table and dropping a table.
1. DML Commands – Insert, Select Commands, update & delete Commands.
3. Creating relationship between the databases – Nested Queries & Join Queries
4. Creating a database and to set various possible constraints.
5. Views – Create a Virtual table (Views) based on the result set of an SQL statement.
6. To create PL/SQL functions and to implement the stored procedures in SQL (Function and Procedures).

Model practical Examination-I

Cycle-2

7. To study the basics of front end tools.
8. To implement the forms using front end tool and use oracle for database creation.
9. Triggers – To create a statement that executes automatically as a side effect of a modification to the DB.
10. Menu Design – To Design menus using menu editor in Visual Basic.
11. Reports – To generate data report from existing DB
12. Minor Project (Application Development using Oracle/Mysql)

Model practical Examination-II

G. Learning Resources:

i. Reference Books:

1. Database Management Systems solutions manual, Raghu Ramakrishnan, Johannes Gehrke, Jeff Derstadt, Scott Selikoff and Lin Zhu, third Edition, 2013
2. SQL with Guru99 by Krishna Rungta, Smashwords 2013
3. A Primer on SQL by Rahul Batra, dreamincode.net 2012
4. Learn SQL The Hard Way by Zed A. Shaw, LCodeTHW 2011
5. Developing Time-Oriented Database Applications in SQL, by Richard T. Snodgrass, Morgan Kaufmann 1999

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS304	OPERATING SYSTEMS LAB	0	0	2	1

Course Category: Program Core

A. Preamble:

Operating systems are the fundamental part of every computing device to run any type of software. The increasing use of computing devices in all areas of life (leisure, work), lead to a variety of operating systems. Yet all operating systems share common principles. These principles are important for computer science students in their understanding of programming languages and software built on top of operating systems. The Operating System Laboratory, OS Lab is a course that will teach students about principles of operating systems using a constructivist approach and problem-oriented learning.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	{HYPERLINK \l "s"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Demonstrate the fundamental UNIX commands & system calls	S3
CO2	Apply the scheduling algorithms for the given problem	S3
CO3	Apply the process synchronous concept using message queue, shared memory, semaphore and Dekker's algorithm for the given situation.	S3
CO4	Experiment an algorithm to detect and avoid dead lock	S3
CO5	Apply the various methods in memory allocation and page replacement algorithm.	S3
CO6	Demonstrate the various operations of file system.	S3

K2-Understand, K3-Apply, S3-Processes

D. Correlation of COs with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2	H	M	L	L		L	L				L	L	M		
CO3	H	M	L			L	L				L				L
CO4	H	M	L	L		L	L				L	L	M		L
CO5	H	M	L	L		L	L				L	L			L
CO6	M	M													

F. Course Content:

Cycle I

Basics of UNIX Commands

1. Write programs using the following system calls of UNIX operating system: fork, exec, getpid, exit, wait, close.
2. Write programs using the I/O System calls of UNIX operating system (open, read, write, etc).
3. Given the list of processes, their CPU burst times. Display/print the Gantt chart for FCFS scheduling algorithm. Compute and print the average waiting time and average turnaround time.
4. Given the list of processes, their CPU burst times and arrival times. Display the Gantt chart for SJF scheduling algorithm. Compute and print the average waiting time and average turnaround time.

Model Practical Examination I

Cycle II

5. Given the list of processes, their CPU burst times and time quantum. Display the Gantt chart for Round robin scheduling algorithm. Compute and print the average waiting time and average turnaround time.
6. Given the list of processes, their CPU burst times and arrival times. Display the Gantt chart for Priority scheduling algorithm. Compute and print the average waiting time and average turnaround time.
7. Develop application using Inter-Process Communication (using shared memory, pipes or message queues).
8. Implement the Producer-Consumer problem using semaphores (using UNIX system calls)
9. Implement Memory management schemes like paging and segmentation.
10. Implement Memory allocation schemes like First fit, Best fit and Worst fit.

Model Practical Examination II

G. Learning Resources:

i. Reference Books:

1. Universal Command Guide: For Operating Systems – April 15, 2002
, by http://www.amazon.com/Guy-Lotgering/e/B001IZRETO/ref=dp_byline_cont_book_1
2. The Easy Guide to Operating Systems, Larry Miller, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
1151CS305	COMPUTER NETWORKS LAB	0	0	2	1

Course Category: Program Core

A. Preamble :

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving Using C
2	1151CS102	Data Structures
3	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS304	Operating System Lab
2	1151CS303	Database Management system Lab
3	1151CS302	Java Programming Lab
4	115CS301	Data Structures Lab
5	1156CS601	Mini Project
6	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Identify the different types of network topologies and protocols.	S3
CO2	Illustrate the various keying techniques, digital data communication techniques and its standards.	S3
CO3	Apply with contemporary issues in networking technologies and Tools.	S3
CO4	Demonstrate the various concepts of network topologies, components and categories of networks with Routing Algorithms.	S3
CO5	Make use of packet /file transmission between nodes.	S3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	L	M	L	L		M		L		L		M	
CO2	H	H	L	M	L	L		M					H	M	
CO3	H	H	H	M	H			M	M						M
CO4	M	M	M	M	L	L	M	M	M				L		L
CO5	H	L	M	M			H	M		H		M		M	H

H- High; M-Medium; L-Low

F. Course Content :

LIST OF EXPERIMENTS:

1. a) Study of different types of network cables and practically implement cross wired cable and straight through cable using clamping tool.
b) Study of network devices and network IP in detail.
2. Study of network IP and practically connect the computers in LAN
3. a) Study of basic network command and network configuration commands.
b) Configure a network topology using packet tracer software.
4. Configure a network using Distance vector/Link state routing protocol.
5. Simulation of sliding window protocol.

6. Simulation of ARP and RARP.
 7. Implementation of File Transfer Protocol
 8. Half Duplex Chat Using UDP
 9. Full Duplex Chat Using TCP/IP
 10. Simulate the packet transmission over Ethernet LAN and its CSMA/CD protocol using NS2.

G. Learning Resources

Text Books:

1. BehrouzForouzan, "Introduction to Data Communications and Networking", Tata McGraw Hill, 5th Edition, 2015.
 2. Stallings, "Data and Computer Communications", PHI, 10th Edition, 2015.

Reference:

1. William Schweder, "Data Communication", McGraw Hill, 1987.
 2. Tanenbaum, "Computer Networks", PHI, 5rd Edition, 2011

Online Resources

1. {HYPERLINK "http://www.cse.iitk.ac.in/users/dheeraj/cs425/"}
 2. {HYPERLINK "http://www.tcpipguide.com/free/t_OSIReferenceModelLayers.htm"}
 3. {HYPERLINK "http://iit.qau.edu.pk/books/Data%20Communications%20and%20Networking%20By%20Behrouz%20A.Forouzan.pdf"}
 4. {HYPERLINK "http://www.networkdictionary.com/protocols/osimodel.php"}

PROGRAM

ELECTIVE

{PAGE }

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS101	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course describes the explosive growth in computer systems and their interconnections via networks, has increased the dependence of both organizations and individuals on the information stored and communicated using these systems. This, in turn, has led to a heightened awareness of the need to protect data and resources from disclosure, to guarantee the authenticity of data and messages, and to protect systems from network-based attacks and the disciplines of cryptography and network security have matured, leading to the development of practical, readily available applications to enforce network security.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS128	Forensics and Cyber Applications
2	1152CS117	Information Security
3	1156CS601	Minor Project
4	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected to

- Learn fundamentals of cryptography and its application to network security.
- Understand network security threats, security services, and countermeasures.
- Acquire background on well known network security protocols such as IPSec, SSL, and WEP.

- Understand vulnerability analysis of network security.
- Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand various Cryptographic Techniques	K2
CO2	Apply various public key cryptography techniques	K3
CO3	Implement Hashing and Digital Signature techniques	K3
CO4	Understand the various Security Applications	K2
CO5	Implement system level security applications	K3

Correlation of COs with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1	PSO1	PSO2	PSO3
CO1	H	M	L	L											
CO2	M	M	M	L	L							L	H	L	
CO3	M	M	M	M		L		L	L		L	L	M	M	M
CO4	M	M	M	M	L	H		L	L		L	L	M	H	
CO5	M		M	L	L			L				M	L	L	M

H- High; M-Medium; L-Low

F. Course Content:

UNIT I : FOUNDATIONS OF CRYPTOGRAPHY AND BLOCK CIPHER TECHNIQUES

9

OSI Security Architecture - Security Attacks and Services. Mathematical Tools for Cryptography: Substitutions and Permutations, Design Principle of Block ciphers: DES and Triple DES- AES- RC5.

UNIT II: PUBLIC KEY CRYPTOGRAPHY 9

Introduction to Number Theory: Prime numbers- Chinese remainder theorem- Fermat and Euler's theorem - RSA- Public Key Management - Diffie-Hellman key Exchange - Elliptic curve Cryptography.

UNIT III: AUTHENTICATION AND HASH FUNCTION 10

Authentication requirements - Authentication functions - Message Authentication Codes - Hash Functions - MD5 message Digest algorithm - Secure Hash Algorithm - SHA 512 – HMAC- Digital Signatures - Authentication Protocols - Digital Signature Standard.

UNIT IV: NETWORK SECURITY 9

Authentication Applications: Kerberos - X.509 Authentication Service - Electronic Mail Security - PGP - S/MIME - IP Security - Web Security.

UNIT V: SYSTEM LEVEL SECURITY 8

Intrusion detection - password management - Viruses and related Threats - Firewall Design Principles - Trusted Systems.

TOTAL: 45 Hours

G. Learning Resources

i. Text Books:

1. Wade Trappe, Lawrence C Washington, " Introduction to Cryptography with coding theory", 2nd ed, Pearson, 2007.
2. William Stallings, "Cryptography and Network security Principles and

Practices", Pearson/PHI, 4th ed, 2006.

3. Atul Kahate, "Cryptography and Network Security", McGraw Hill, 3rd ed, 2003

ii. Reference Books:

1. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger – Security in computing Third Edition -Prentice Hall of India, 2006.

iii. Online Resources:

1. williamstallings.com/Extras/Security-Notes/
2. {HYPERLINK "http://www.cs.bilkent.edu.tr/%7Eselcuk/teaching/cs519/" \h}
3. {HYPERLINK "http://freevideolectures.com/Course/3027/Cryptography-and-Network-"\h} Security
4. {HYPERLINK "http://cs.brown.edu/courses/csci1510/2013_lectures.html" \h}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS102	HIGH SPEED NETWORK	3	0	0	3

Course Category: Program Elective

A. Preamble:

To introduce the new developments in modern networking systems, multimedia communications and high speed networks.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name

1	1152CS101	Cryptography and Network Security.
2	1152CS107	Mobile Adhoc and Sensor Networks.

D. Course Educational Objectives:

Students undergoing this course are exposed to

- Demonstrate the knowledge of network planning and optimization
- Develop an in-depth understanding, in terms of architecture, protocols and applications, of major high-speed networking technologies
- Evaluate various technologies and identify the most suitable one to meet a given set of requirements for a hypothetical corporate network
- Develop necessary background to be able to manage projects involving any of the high-speed networking technologies

E. Course Outcomes :

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Explain the Asynchronous Transfer Mode Protocol architecture and High Speed Local Area Network Applications.	K2
C02	Apply the Queuing Models, frame relay to manage the traffic and congestion control in High Speed Network.	K3
C03	Compare congestion control and traffic management in TCP with Asynchronous Transfer Mode protocol in High Speed Networks	K2
C04	Explain the Architecture of Integrated and Differentiated services	K2
C05	Outline the protocols for Quality of Service Support	K2

F. Correlation of COs with POs:

CO s	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PS0 1	PS0 2	PS0 3
CO 1	M	L	L	L		L					M		L	M	
CO 2	H	M	M				L						M		M
CO 3	M	L	L												
CO 4	M	M	M	L									M		
CO 5	M	L	L				L							M	M

H- High; M-Medium; L-Low

G. Course Content :

UNIT I HIGH SPEED NETWORKS

9

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection – ATM Cell – ATM Service Categories – AAL. High Speed LAN's: Fast Ethernet – Gigabit Ethernet– Fibre Channel – Wireless LAN's, WiFi and WiMax Networks applications, requirements – Architecture of 802.11.

UNIT II CONGESTION AND TRAFFIC MANAGEMENT

8

Queuing Analysis – Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

UNIT III TCP AND ATM CONGESTION CONTROL

12

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats – ABR Capacity allocations – GFR traffic management.

UNIT IV INTEGRATED AND DIFFERENTIATED SERVICES

8

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline – FQ – PS – BRFQ – GPS – WFQ – Random Early Detection – Differentiated Services.

UNIT V PROTOCOLS FOR QOS SUPPORT

8

RSVP – Goals & Characteristics, Data Flow, RSVP operations – Protocol Mechanisms– Multiprotocol Label Switching – Operations, Label Stacking – Protocol details – RTP – Protocol Architecture – Data Transfer Protocol– RTCP.

Total: 45Hours

H. Learning Resources:

i. Text Books:

1. William Stallings, "High speed networks and internet", Second Edition, Pearson Education, 2002.

ii. References:

1. Warland, Pravin Varaiya, "High performance communication networks", Second Edition , Jean Harcourt Asia Pvt. Ltd., , 2001.
2. IrvanPepelnjk, Jim Guichard, Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.
3. Abhijit S. Pandya, Ercan Sea, "ATM Technology for Broad Band Telecommunication Networks", CRC Press, New York, 2004

.iii. Online Resources:

1. <https://www.sics.se/~peter/HSN-visions.html>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS103	NETWORK PROTOCOLS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This Course helps the learners to know the basics of computer networks, TCP/IP protocol indepth considering design alternatives and implementation techniques.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1150CS201	Problem Solving using C
3	1151CS102	Data Structures
4	1151CS305	Computer Networks Lab

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and Network Security.

D. Course Educational Objectives:

Students undergoing this course are exposed to

- Study the internals of the TCP/IP protocols.
- Work how TCP/IP is actually implemented.
- Gain knowledge about the interaction among the protocols in a protocol stack.

E. Course Outcomes :

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Understand the concept of Internetworking and IP protocols.	K2
C02	Describe the various functions of TCP.	K2
C03	Summarize different routing protocols and understand the mechanism of IP Protocols.	K2
C04	Understand the TCP implementation using different techniques.	K2
C05	Describe the timer mechanism, flow control, congestion control of data.	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO 3
CO1.	M	L	L		L			L				M			H
CO2.	H	L	L		M			L				M	L	M	H
CO3	H	L	L	L	M			L				M	M	M	H
CO4	H	M	M	L	M			L				M	L	M	H
CO5	H	L	L	L	L			L				M	L	M	H

H- High; M-Medium; L-Low

G. Course Content :

UNIT I INTRODUCTION	9
Internetworking concepts and architecture model – class ful Internet address – CIDR – Subnetting and Supernetting – AARP – RARP- IP- IP Routing – ICMP – IPV6.	

UNIT II TCP	9
Services – header – connection establishment and termination – interactive data flow – bulk data flow – timeout and retransmission – persist timer – keep alive timer – futures and performance.	

UNIT III IP IMPLEMENTATION	9
IP global software organization – routing table – routing algorithms – fragmentation and reassembly – error processing (ICMP) – Multicast Processing (IGMP).	

UNIT IV TCP IMPLEMENTATION I	9
Data structure and input processing – transmission control blocks – segment format – comparison – finite state machine implementation – Output processing – mutual exclusion – computing the TCP Data length.	

UNIT V TCP IMPLEMENTATION II	9
Timers – events and messages – timer process – deleting and inserting timer event –flow control and adaptive retransmission – congestion avoidance and control – urgentdata processing and push function.	

Total: 45 Hours

H. Learning Resources:

i. Text Books:

1. Douglas E Comer," Internetworking with TCP/IP Principles, Protocols and Architecture", Vol1 ,VIth Edition, Addison-Wesley Professional,2013
2. W.RichardStevans "TCP/IP Illustrated" Pearson Education Vol 1. 2012.

ii. References:

1. Forouzan, " TCP/IP Protocol Suite" Fourth Edition, Tate MC Graw Hill, 2010.
2. W.Richard Stevens "TCP/IP Illustrated" Volume 2, Pearson Education 2003

iii. Online Resources:

1. {HYPERLINK "http://www.tcpipguide.com/free/t_toc.htm"}
2. {HYPERLINK "http://www.docwiki.cisco.com/wiki/Internetworking_Basics"}
- 3.www.repo.hackerzvoice.net/depot_madchat/ebooks/TCP-IP_Illustrated/tcp_tran.html

{PAGE }

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS104	ETHICAL HACKING	3	0	0	3

Course Category: Program Elective

A. Preamble:

The objective of this course is to familiarize students with hacking techniques, methodologies, tools, tricks, and security measures to secure an organization's IT systems.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are exposed to

- Ethical Hacking ethically penetrates into network systems using various tools to test the strength of a network.
- Ethical Hacking course shows how to test, scan, hack and secure networks and systems.
- Get in-depth theoretical knowledge and rich practical experience in hacking test networks.

E. Course Outcomes :

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understanding the basics of networking with the introduction on the system attacks	K2
CO2	Describes attacks in terms of industry, society and information systems	K2
CO3	Describes various types of securities and vulnerabilities	K2
CO4	Demonstration of the ethical hacking tools	K3
CO5	Summarizing the legal and professional responsibilities of ethical hacking	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L			L			H					L		L
CO2	L	L			M			H		L			L	L	L
CO3	L	M			L			H		L	L		L	L	L
CO4		M			H			H	M	L	L			M	M
CO5		M			L			H							H

H- High; M-Medium; L-Low

G. Course Content :**UNIT -I**

9

Ethical Hacking: Introduction, Networking & Basics, Foot Printing, Google Hacking, Scanning, Windows Hacking, Linux Hacking, Trojans & Backdoors, Virus & Worms, Proxy & Packet Filtering, Denial of Service, Sniffer, Social Engineering,

UNIT -II

9

Introduction to Computer Systems and Networks , information systems and networks (including wireless networks) and their role in industry business and society, System and Network Vulnerability and Threats to Security , various types of attack and the

various types of attackers in the context of the vulnerabilities associated with computer and information systems and networks

UNIT -III 9
Physical Security, Steganography, Cryptography, Wireless Hacking, Firewall & Honeypots, IDS & IPS, Vulnerability, Penetration Testing, Session Hijacking, Hacking Web Servers, SQL Injection, Cross Site Scripting, Exploit Writing, Buffer Overflow, Reverse Engineering, Email Hacking, Incident Handling & Response, Bluetooth Hacking, Mobile Phone Hacking

UNIT -IV 9
An introduction to basic ethical hacking tools and usage of these tools in a professional environment in a form of project

UNIT -V 9
An introduction to the particular legal, professional and ethical issues likely to face the domain of ethical hacking. Ethical responsibilities, professional integrity and making appropriate use of the tools and techniques associated with ethical hacking.

TOTAL: 45 Hours

H. Learning Resources

i. Text Books:

1. Hands-On Ethical Hacking and Network Defense – By Michael T. Simpson, Kent Backman, James Corley
2. Official Certified Ethical Hacker Review Guide – By Steven DeFino, Barry Kaufman, Nick Valenteen.

ii. Reference Books:

1. The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made Easy (Syngress Basics Series) [Paperback]
2. Hands-On Ethical Hacking and Network Defense [Print Replica] [Kindle Edition]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS105	UBIQUITOUS COMPUTING	3	0	0	3

Course Category: Program Elective

A. Preamble :

The course aims at providing a sound conceptual foundation in the area of Pervasive Computing aspects. The course attempts to provide a balanced treatment of the mechanisms and environments of pervasive computing and initiate CS students to the state-of-the-art in the area. At the end of this course, students be able to conceptualize, analyze and design pervasive computing systems

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C
2	1151CS101	Concrete mathematics

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS103	Programming in Java
2	1151CS117	Java Programming
3	1151CS111	Computer Networks

D. Course Educational Objectives:

Learners are exposed to

- understand the basics of Ubiquitous Computing
- know the concepts of web application
- know the aspects of voice technology
- develop pervasive application

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basic concepts of Ubiquitous Computing	K2
CO2	Illustrate web application concepts in Ubiquitous Computing	K2
CO3	Summarize speech recognition and its standards	K2
CO4	Develop pervasive application	K3
CO5	Utilize WAP functionality to establish connected devices	K3

F. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												L		
CO2	M		M		M			L							
CO3	M		M	M	M							L		M	M
CO4	H	M	M	M	M	L	L	L	M	L	M	L		M	M
CO5	H	M	M	M	M	L		L	M		M			M	M

G. Course Content:

UNIT I – INTRODUCTION

9

Past, present, future; the pervasive computing market, m-Business, Challenges and future of Pervasive Computing- Application Examples of Pervasive Computing: Retail, Airline Check-in and booking, Sales force automation, Healthcare, Tracking, Car Information Systems, Email Access via WAP and voice-DeviceTechnology for PervasiveComputing : Hardware, Human-machine interfaces, Biometrics, Operating Systems, Java for pervasivedevices, Outlook- Device Connectivity: Protocols, Security, Device Management

UNIT II - WEB APPLICATION CONCEPTS

9

History, WWW architecture, Protocols, Trans-coding, Client Authentication via the Internet for pervasive computing- WAP and beyond: Introduction, Components of the WAP architecture, WAP infrastructure, WAP security issues, Wireless Markup Language, WAP push, Products, i-Mode, Outlook

UNIT III – COMPUTING TECHNOLOGY 9
Voice Technology: Basics of Speech Recognition, Voice standards, Speech Applications, Speech and Pervasive Computing, Security – Personal Digital Assistants: History, Device Categories, Personal Digital Assistant Operating Systems, Device Characteristics, Software Components, Standards, Mobile applications, Personal Digital Assistant Browsers- Server-side programming (Java) for pervasive computing: Java 2 Enterprise Edition (Overview), Servlets, Enterprise Java Beans, Java Server Pages, Extensible Markup Language, Web Services, Model-View-Controller pattern

UNIT IV – WEB APPLICATION ARCHITECTURE 9
Background, Scalability & Availability, Development of pervasive computing Web Applications, Pervasive Application Architecture- Example, Pervasive Application: Introduction, User Interface Overview, Architecture, Implementation- Access from PCs: Smart-card authentication via the Internet, Ordering goods

UNIT V – WAP FUNCTIONALITY 9
Access via WAP: WAP functionality, Implementation- Access from Personal Digital Assistants: Extending the example application to personal digital assistants, Implementation for synchronized devices, Implementation for connected devices- Access via Voice: Extending the example application to voice access, Implementation
TOTAL: 45 Hours

H. Learning Resources

i.Text Books:

1. {HYPERLINK "http://www.bestwebbuys.com/books/search/t/Author/q/Jochen%20Burkhardt%2C%20Horst%20Henn%2C%20Stefan%20Hepper%2C%20Thomas%20Schaeck%2C%20Klaus%20Rindtorff/isrc/b-compare-author"}: Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Pearson Education, New Delhi, 2006.

ii.Reference Books:

1. StefenPoslad: Ubiquitous Computing: Smart Devices, Environments and Interactions, Wiley, Student Edition, 2010.
2. Frank Adelstein, S K S Gupta, GG Richard & L Schwiebert: Fundamentals of Mobile and Pervasive Computing, Tata McGraw-Hill, New Delhi, 2005.

1. Online resources

1. {HYPERLINK "http://cis.k.hosei.ac.jp/~jianhua/course/ubi/Lecture01.pdf"}

2. {HYPERLINK

"http://ocw.metu.edu.tr/pluginfile.php/1177/mod_resource/content/0/Schedule/se705_week14.pdf"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS106	MOBILE COMPUTING	3	0	0	3

Course Category: Program Elective

A. Preamble :

Communication technologies in this era become one of the dominant fields. Especially handheld devices growth such as PDA, Mobile Phones, Tablet, makes use of GSM or 3G for both voice and data. It is must for the computer science engineer to learn the Basics of Wireless and data Communication Technologies. About the various Satellites Networks and WirelessLAN Standards. To known about the various Mobile computing algorithms and Wireless application protocol to Develop mobile content applications.

B. Prerequisite Courses:

S1 No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

S1 No	Course Code	Course Name
1	1152CS107	Mobile Adhoc and Sensor Networks

D. Course Educational Objectives :

Students undergoing this course are exposed to

- The basics of Wireless voice and data communications technologies.
- Build working knowledge on various telephone and satellite networks.
- The working principles of wireless LAN and its standards.
- Build knowledge on various Mobile Computing algorithms.
- Build skills in working with Wireless application Protocols to develop mobile content applications.

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basics of wireless communication systems.	K2
CO2	Explain the concepts of Telecommunication networks	K2
CO3	Discuss wireless LAN standards.	K2
CO4	Describe various routing protocols algorithm standards	K2
CO5	Illustrate Wireless application Protocols to develop mobile content application and to appreciate the social and ethical issues of mobile computing, including privacy.	K3

F. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M				L			M					M		L
CO2	M		L		M			M					M	M	L
CO3	M		M		M			M					M	M	L
CO4	M		M		M			M					M	M	L
CO5	M	L	L	L	M			M	H				M	M	M

H- High; M-Medium; L-Low

G. Course Content :**UNIT I Wireless Communication Fundamentals**

9

Introduction – Wireless transmission – Frequencies for radio transmission – Signals – Antennas – Signal Propagation – Multiplexing – Modulations – Spread spectrum – MAC – SDMA – FDMA – TDMA – CDMA – Cellular Wireless Networks.

UNIT II Telecommunication Networks

9

Telecommunication systems – GSM – GPRS – DECT – UMTS – IMT-2000 – Satellite Networks - Basics – Parameters and Configurations – Capacity Allocation – FAMA and DAMA – Broadcast Systems – DAB – DVB.

UNIT III WIRELESS LAN	9
Wireless LAN – IEEE 802.11 – Architecture – services – MAC – Physical layer – IEEE 802.11a – 802.11b standards – HIPERLAN – Blue Tooth.	
UNIT IV Mobile Network Layer	9
Mobile IP – Dynamic Host Configuration Protocol – Routing – DSDV – DSR – Alternative Metrics.	
UNIT V Transport And Application Layers	9
Traditional TCP – Classical TCP improvements – WAP, WAP 2.0.	
	Total : 45 Hours

H. Learning Resources:

- i. **Text Books**
 - ii. Jochen Schiller, "Mobile Communications", PHI/Pearson Education, Second Edition, 2003.
(UNIT I Chap 1,2 &3- UNIT II chap 4,5 &6-UNIT III Chap 7.UNIT IV Chap 8- UNIT V Chap 9&10.)
 - iii. William Stallings, "Wireless Communications and Networks", PHI/Pearson Education, 2002. (UNIT I Chapter – 7&10-UNIT II Chap 9)
- iii. **Reference Books:**
 - 1. KavehPahlavan, PrasanthKrishnamoorthy, "Principles of Wireless Networks", PHI/Pearson Education, 2003.
 - 2. Uwe Hansmann, LotharMerk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, New York, 2003.
 - 3.Hazysztowesolowski, "Mobile Communication Systems", John Wiley and Sons Ltd, 2002.
- iii. **Online resources**
 - 1. [http://www.tutorialspoint.com/Mobile Networks](http://www.tutorialspoint.com/Mobile%20Networks)

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS107	MOBILE ADHOC AND SENSOR NETWORKS	3	0	0	3

Course Category: Program Elective

A. Preamble:

To Learn the Basics of Sensor network and Mobile Ad hoc Networks with its Protocol Design. To Develop MAC routing protocol for sensor and mobile Networks .To Study an efficient protocol for sensor Network. Design the protocol for Sensor and mobile Network.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected to:

- To understand the principles of sensor networks and mobile ad hoc networks, and their impact on protocol design
- To develop MAC and routing protocols for sensor and mobile networks
- To develop efficient protocols for sensor and mobile networks
- To understand and develop information dissemination protocols for sensor and mobile networks

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand routing mechanisms and its types for unicast and multicast routing.	K2
CO2	Identify the issues and challenges in providing QoS.	K2
CO3	Explain about energy management in adhoc	K2

	networks.	
CO4	Describe various types of mesh networks and have knowledge in network configuration.	K2
CO5	Apply this knowledge to analyze sensor based networks and compute various parameters associated with it.	K2

F. Correlation of Cos with Pos:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	M	M	M								M		L
CO2	M		L		M								M		L
CO3	M		M		M								M		L
CO4	M		M		M								M	L	L
CO5	M		M		M								M	L	L

G. Course Content:

UNIT I ROUTING

L-9

Cellular and Ad hoc wireless networks – Issues of MAC layer and Routing – Proactive, Reactive and Hybrid Routing protocols – Multicast Routing – Tree based and Meshbased protocols – Multicast with Quality of Service Provision

UNIT II QUALITY OF SERVICE

L-9

Real-time traffic support – Issues and challenges in providing QoS – Classification ofQoS Solutions – MAC layer classifications – QoS Aware Routing Protocols – Ticket based and Predictive location based QoS Routing Protocols

UNIT III ENERGY MANAGEMENT AD HOC NETWORKS

L-9

Need for Energy Management – Classification of Energy Management Schemes – Battery Management and Transmission Power Management Schemes – Network Layerand Data Link Layer Solutions – System power Management schemes

UNIT IV MESH NETWORKS

L-9

Necessity for Mesh Networks – MAC enhancements – IEEE 802.11s Architecture – Opportunistic Routing – Self Configuration and Auto Configuration – Capacity Models – Fairness – Heterogeneous Mesh Networks – Vehicular Mesh Networks

UNIT V SENSOR NETWORKS

L-9

Introduction – Sensor Network architecture – Data Dissemination – Data Gathering – MAC Protocols for sensor Networks – Location discovery – Quality of

TOTAL = 45 Hours

H. Learning Resources

i.Text Books:

1. C. Siva Ram Murthy and B.S. Manoj, "Ad hoc Wireless Networks – Architectures and Protocols", Pearson Education, 2004

ii. Reference:

1. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks", MorganKaufmanPublishers, 2004
2. C.K. Toh, "Adhoc Mobile Wireless Networks", Pearson Education, 2002.
3. Thomas Krag and SebastinBuetrich, 'Wireless Mesh Networking', O'ReillyPublishers.

iii. Online resources

1. Archive.cone.informatik.uni-freiburg.de/.../lecture/.../MANET-01.ppt
2. {HYPERLINK "<http://www.rimtengg.com/coit2007/proceedings/pdfs/122.pdf>"}
3. people.cs.vt.edu/~irchen/6204/.../lecture4-mobile-ad-hoc-networks.p.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS108	USER INTERFACE DESIGN	3	0	0	3

A. Preamble :

The {HYPERLINK "https://en.wikipedia.org/wiki/Design" \o "Design"} of {HYPERLINK "https://en.wikipedia.org/wiki/User_interface" \o "User interface"} for {HYPERLINK "https://en.wikipedia.org/wiki/Machine" \o "Machine"} and {HYPERLINK "https://en.wikipedia.org/wiki/Software" \o "Software"}, such as {HYPERLINK "https://en.wikipedia.org/wiki/Computer" \o "Computer"}, {HYPERLINK "https://en.wikipedia.org/wiki/Home_appliance" \o "Home appliance"}, {HYPERLINK "https://en.wikipedia.org/wiki/Mobile_device" \o "Mobile device"}, and other {HYPERLINK "https://en.wikipedia.org/wiki/Electronics" \o "Electronics"}, with the focus on maximizing the {HYPERLINK "https://en.wikipedia.org/wiki/User_experience" \o "User experience"}. The goal of user interface design is to make the user's interaction as simple and efficient as possible, in terms of accomplishing user goals ({HYPERLINK "https://en.wikipedia.org/wiki/User-centered_design" \o "User-centered design"}).

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150MA202	Engineering Mathematics I

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS102	Data Structures
2	1151CS113	Computer Graphics and Image Processing

D. Course Educational Objectives :

Learners are exposed to

- Describe the web user Interface
- Describe the structure of user Interface and design process
- Organize the web systems and control

E. Course Outcomes :

Upon the successful completion of the course, students will be able to

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Describe the Characteristics of Graphics Interface and its Principles	K2
CO2	Design the standards and structures for Human computer interaction	K2
CO3	Understand the components of web systems and text boxes	K2
CO4	Demonstrate the Guidance of multimedia systems and its accessibility	K3
CO5	Summarize the concepts of windows layout and visualization	K2

F. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		M											L	
CO2	M	L	M	L											M
CO3	M	L	M	L				L							
CO4	M		M						L		L			L	M
CO5	H	L	M	L	L			L				L			

H- High; M-Medium; L-Low

G. Course Content:

UNIT I INTRODUCTION 8
Human-Computer Interface – Characteristics Of Graphics Interface –Direct Manipulation
Graphical System – Web User Interface –Popularity –Characteristic & Principles.

UNITII HUMAN COMPUTER INTERACTION 10
User Interface Design Process – Obstacles –Usability –Human Characteristics In Design – Human Interaction Speed –Business Functions –Requirement Analysis – Direct – Indirect Methods – Basic Business Functions – Design Standards – System Timings –

Human Consideration In Screen Design – Structures Of Menus – Functions Of Menus– Contents Of Menu– Formatting – Phrasing The Menu – Selecting Menu Choice– Navigating Menus– Graphical Menus.

UNIT III WINDOWS 9

Characteristics– Components– Presentation Styles– Types– Managements– Organizations– Operations– Web Systems– Device– Based Controls Characteristics– Screen – Based Controls – Operate Control – Text Boxes– Selection Control– Combination Control– Custom Control– Presentation Control.

UNIT IV MULTIMEDIA 9

Text For Web Pages – Effective Feedback– Guidance & Assistance– Internationalization– Accesssibility– Icons– Image– Multimedia – Coloring.

UNIT V WINDOWS LAYOUT– TEST 9

Prototypes – Kinds Of Tests – Retest – Information Search – Visualization – Hypermedia – WWW– Software Tools.

TOTAL: 45 Hours

H. Learning Resources

i.Text Books:

1. Wilbert. O. Galitz , "The Essential Guide To User Interface Design", John Wiley& Sons, 2001.
2. Ben Sheiderman, "Design The User Interface", Pearson Education, 1998.

ii.Reference Books:

1. Alan Cooper, "The Essential Of User Interface Design", Wiley – Dream Tech Ltd., 2002.

iii. Online resources

<http://www.annaunivedu.in/2012/08/it2024-user-interface-design-syllabus.html#ixzz3xlplel6R>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS109	COMPONENT BASED TECHNOLOGY	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course Component Based Technology provides an introduction and Basic Concepts of Various Platform Component Based Technology

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS202	Internet Programming

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives :

Students are exposed to:

- Introduces in depth JAVA, CORBA and .Net Components
- Deals with Fundamental properties of components, technology and architecture and middleware.
- Component Frameworks and Development are covered in depth.

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the fundamentals of software components and their architecture	K2
CO2	Develop a Java Thread and Create a bean for an application	K3
CO3	Develop and Implement CORBA Based Technology Component	K3
CO4	Illustrate and Implement .NET Based Technology Component	K3
CO5	Discuss Component Based connectors, development and testing Tools	K2

Correlation of Cos with Program outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L							M					L		L
CO2	L		L					M		L	L		L	H	L
CO3	L		L		H			M		L	L		L	H	L
CO4	L		L		H			M		L	L		L	H	L
CO5	L		L		H			M		L			L	H	L

F. Course Content:

UNIT I INTRODUCTION	9
Software Components – objects – fundamental properties of Component technology – modules – interfaces – callbacks – directory services – component architecture – components	and middleware
UNIT II JAVA BASED COMPONENT TECHNOLOGIES	9
Threads – Java Beans – Events and connections – properties – introspection – JAR files – reflection – object serialization – Enterprise Java Beans – Distributed Object models – RMI	and RMI-IIOP
UNIT III CORBA COMPONENT TECHNOLOGIES	9
Java and CORBA – Interface Definition language – Object Request Broker – system object model – portable object adapter – CORBA services – CORBA component model – containers – application server – model driven architecture	
UNIT IV .NET BASED COMPONENT TECHNOLOGIES	9
COM – Distributed COM – object reuse – interfaces and versioning – dispatch interfaces – connectable objects – OLE containers and servers – Active X controls – .NET components – assemblies – appdomains – contexts – reflection – remoting	
UNIT V COMPONENT FRAMEWORKS AND DEVELOPMENT	9
Connectors – contexts – EJB containers – CLR contexts and channels – Black Box	

component framework – directory objects – cross-development environment – component-oriented programming – Component design and implementation tools – testing tools – assembly tools.

TOTAL: 45 Hours

G. Learning Resources

i. Text Books

1. Clemens Szyperski, "Component Software: Beyond Object-Oriented Programming", Pearson Education publishers, 2013

ii. REFERENCES

1. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons Inc., 2012.
2. Mowbray, "Inside CORBA", Pearson Education, 2013.
3. Freeze, "Visual Basic Development Guide for COM & COM+", BPB Publication, 2011.
4. Hortsamann, Cornell, "CORE JAVA Vol-II" , Sun Press, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS110	KNOWLEDGE BASED DECISION SUPPORT SYSTEM	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course provides an introduction to the basic concepts and techniques of how to manage Knowledge in an Intelligent Decision Support Systems.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS107	Database Management System

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS114	Data Warehousing and Data Mining

Course Educational Objectives:

Learners are exposed to

- Development of support system
- Methods of managing knowledge
- Intelligent decision system development

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Outline the concepts of Decision Making System	K2
CO2	Illustrate the visualization concepts of decision support system	K2
CO3	Explain enterprise management systems	K2
CO4	Summarize the case based reasoning system.	K2
CO5	Apply e commerce on future management support systems	K3

E. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M										M			
CO2		H											L		
CO3	M														
CO4	M	H		L			L				L			M	L
CO5	M		M	M		L		L			L			M	L

H- High; M-Medium; L-Low

F. Course Content:

Unit I

9

Decision Making and computerized support: Management support systems. Decision making systems 124rayscal- support.

Unit II

9

Decision Making Systems – Modelling and Analysis – Business Intelligence – Data Warehousing, Data Acquisition – Data Mining. Business Analysis – Visualization - Decision Support System Development.

Unit III

9

Collaboration, Communicate Enterprise Decision Support System & Knowledge management – Collaboration Com Technologies Enterprise information system – knowledge management.

Unit IV

9

Intelligent Support Systems – AI & Expert Systems – Knowledge based Systems – Knowledge Acquisition , Representation & Reasoning, Advanced intelligence system – Intelligence System over internet.

Unit V

9

Implementing MSS in the E-Business ERA – Electronic Commerce – integration, Impacts and the future management support systems.

TOTAL: 45 Hours

G. Learning Resources

i. Text Books:

1. Decision Support Systems & Intelligent Systems – Seventh edition Efraim Turban& Jay E. Aronson Ting-Peng Liang – Pearson/prentice Hall
2. Decision support Systems – Second Edition – George M Marakas – Pearson/prentice Hall.

ii. Reference Books:

1. Decision Support Systems – V.S. Janakiraman& K. Sarukesi
2. Decision Support systems and Data warehouse Systems by Efrem G Mallach- Mc Graw Hill

iii Online resources

1. {HYPERLINK "http://nptel.ac.in/courses/105108081/module9/lecture39/lecture.pdf" \h}
{HYPERLINK "http://lecture-notes-forstudents.blogspot.in/2010/04/knowledge-based-decision-support-"} system_03.html

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS111	MULTIMEDIA SYSTEMS	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course provides adequate knowledge in multimedia applications and usage of tools used in multimedia environment.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS201	Problem solving using C

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives :

Students undergoing this course are exposed to

- Multimedia concepts and various I/O technologies.
- Develop their creativity in multimedia
- Basic in multimedia operating system

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the characteristics of different media, multimedia data, data formats and multimedia system designs.	K2
CO2	Demonstrate various Multimedia tools and compression techniques.	K3
CO3	Apply the basic operations of Multimedia operating systems.	K3
CO4	Discuss the various reference models needed for synchronization.	K2
CO5	Model the multimedia systems according to the requirements of	K3

	multimedia applications.	
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F. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L												L		L
CO2	L			H			H	M					L		L
CO3	L										H		L	H	L
CO4	L								M				L		L
CO5	L		M	H	H			H	H	L	H		L	H	L

H- High; M-Medium; L-Low

G.Course Content :

UNIT I

9

INTRODUCTION: Elements of multimedia system – Need and aspects of multimedia – Information units.

MULTIMEDIA: Sound – Audio file formats – MIDI – Images – Computer Image Processing – Principles of animation – Animation techniques – Creating animated scenes – Video – Basic concepts – Video Capture – Recording format – Storage for multimedia – CD Technologies – Multimedia Workstations

UNIT II

9

MULTIMEDIA TOOLS: Basic tools – Image-editing tool – Painting and drawing tools – Sound editing programs – Video formats – Linking multimedia objects – OLE – presentation tools – authoring tools. **DATA COMPRESSION:** Source entropy and hybrid coding – JPEG – MPEG – H.261 – DVI

UNIT III

9

MULTIMEDIA OPERATING SYSTEMS: Introduction – Real Time – Resource Management – Process Management – File Systems – Database Systems – Multimedia Database Management System – Characteristics of an MDBMS – Data Analysis – Data Structure – Operations on Data – Integration in a Database Model

UNIT IV 9

MULTIMEDIA COMMUNICATION SYSTEMS: Application Subsystem – Transport Subsystem – Synchronization –Introduction – Notion of Synchronization – Presentation Requirements – A Reference Model for Multimedia Synchronization – Synchronization in distributed environment

UNIT V 9

MULTIMEDIA APPLICATIONS: Video conferencing – Tele conferencing – Tele services – messaging services – retrieval services – Tele action services

TOTAL: 45 Hours

G. Learning Resources**i.Text Books :**

1. Ralf Steinmetz, KlaraNahrstedt, "Multimedia: Computing, Communications and Applications", Pearson Education Asia, New Delhi, 2009.

ii.Reference:

1. Tay Vaughan, "Multimedia: Making it work", sixth edition, Tata McGraw Hill, New Delhi, 2006.
1. Fred Halsall, "Multimedia Communication, Application Networks, Protocols and Standard", fourth edition, Addison Wesley, New Delhi, 2009.
2. John F.Koegal Buford, "Multimedia Systems", Pearson Educational Asia, New Delhi, 2009.
3. Ron, Goldberg, "Multimedia Producer's Bible", fifth edition, Comdex Computer Publishing, New Delhi, 1996.

iv. Online resources

1. surendar.chandrabrown.org/teach/spr09/cse40373/lecture.html
2. {HYPERLINK "<http://www.cs.bc.edu/~hjiang/c335/notes/index.html>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS112	HUMAN-COMPUTER INTERACTION	3	0	0	3

Course Category: Program Elective

A. Preamble:

To introduce the fundamentals of human-computer interaction, user interface design, and usability analysis. Students will learn principles and guidelines for usability, quantitative and qualitative analysis methods, and apply them through critiques of existing interfaces and development of new ones.

B. Pre-requisite

Sl. No	Course Code	Course Name
1	1150MA202	Engineering Mathematics I
2	1151CS109	Theory of Computation

C. Link to Other courses

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objective

Students undergoing this course are expected to

- Critically discuss common methods in the user-centered design process and the appropriateness of individual methods for a given problem.
- Use, adapt and extend classic design standards, guidelines, and patterns.
- Employ selected design methods and evaluation methods at a basic level of competence.
- Build prototypes at varying levels of fidelity, from paper prototypes to functional, interactive prototypes.

E. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Describe the basics of HCI	K2
CO2	Explain the models used for HCI	K2
CO3	Explain various rules used in HCI	K2
CO4	Describe the Empirical research methods	K2
CO5	Design various Dialog Design used for HCI	K3

Correlation of Cos with Programme Outcomes:

Upon the successful completion of the course, students will be able to:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PS O3
CO 1	M														
CO 2	M	H							L					M	
CO 3	H			M					M						M
CO 4	M		H	M										M	
CO 5	M														M

H- Strong; M-Medium; L-Low

F. Course content

UNIT 1 – Introduction

9

Historical evolution of the field – Concept of usability – definition and elaboration – HCI and software engineering – GUI design and aesthetics – Prototyping techniques

UNIT 2 – Model-based Design and evaluation

9

Basic idea, introduction to different types of models, GOMS family of models (KLM and CMN-GOMS)- Fitts' law and Hick-Hyman's law- Model-based design case studies

UNIT 3 – Guidelines in HCI	9
Schneiderman's eight golden rules – Norman's seven principles – Nielsen's ten heuristics with example of its use – Heuristic evaluation – Contextual inquiry – Cognitive walkthrough	

UNIT 4 – Empirical research methods in HCI	9
Introduction (motivation, issues, research question formulation techniques) – Experiment design and data analysis (with explanation of one-way ANOVA) – Hierarchical task analysis (HTA) – Engineering task models and Concur Task Tree (CTT)	

UNIT 5 – Dialog Design	9
Introduction to formalism in dialog design, design using FSM (finite state machines) – State charts and (classical) Petri Nets in dialog design – Introduction to CA, CA types, relevance of CA in IS design – Model Human Processor (MHP)	

TOTAL: 45 Hours

G. Learning Resources

i. Text Book:

1. Dix A., Finlay J., Abowd G. D. and Beale R. *Human Computer Interaction*, 3rd edition, Pearson Education, 2005.
2. Preece J., Rogers Y., Sharp H., Baniyan D., Holland S. and Carey T. *Human Computer Interaction*, Addison-Wesley, 1994.
3. B. Schneiderman; *Designing the User Interface*, Addison Wesley 2000 (Indian Reprint).

ii. Reference Books

1. Preece J., Rogers Y., Sharp H., Baniyan D., Holland S. and Carey T. *Human Computer Interaction*, Addison-Wesley, 1994.
2. B. Schneiderman; *Designing the User Interface*, Addison Wesley 2000 (Indian Reprint).
3. Selected research papers (details will be provided at the end of relevant materials).
4. Jacob Nielsen; *Usability Engineering*; Morgan Kaufmann, Academic Press, London,

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS113	COMPUTER VISION	3	0	0	3

Course Category: Program Elective

v. Preamble :

To understand the fundamental concepts, problems and solution techniques in computer vision including image formation, structure estimation, motion estimation and object estimation. This course treats vision as a process of inference from noisy and uncertain data and emphasizes probabilistic, statistical, data-driven approaches.

vi. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS113	Computer Graphics and Image Processing

vii. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

viii. Course Educational Objectives :

Upon Completion of the course, the students will be able to

- Recall image processing techniques for computer vision
- Do shape and region analysis
- Elucidate Hough Transform and its applications to detect lines, circles, ellipses
- Apply three-dimensional image analysis techniques
- Exploit motion analysis
- Study real world applications of computer vision algorithms

ix. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain

CO1	Explain the basic image processing techniques	K2
CO2	Interpret in-shape , boundary tracking and apply chain codes in region detection	K2
CO3	Apply hough transform for detection of geometric shapes like line, ellipse and objects.	K3
CO4	Illustrate 3D vision process and motion estimation techniques	K2
CO5	Apply computer vision in real time scenario.	K3

x. Correlation of Cos with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		M		L								L	L	
CO2	H	M		M	M		L						L	L	
CO3	M	M	H	L	M		M						H	L	
CO4	H	M	L	L	M								L	L	
CO5			H	L	M		M						L	L	L

xi. Course Content:

UNIT I IMAGE PROCESSING FOUNDATIONS

9

Fundamentals Of Image Processing Techniques – Classical Filtering Operations – Thresholding Techniques – Edge Detection Techniques – Corner And Interest Point Detection –Mathematical Morphology –Texture

UNIT II SHAPES AND REGIONS

9

Binary Shape Analysis – Connectedness – Object Labeling And Counting – Size Filtering – Distance Functions – Skeletons And Thinning – Deformable Shape Analysis – Boundary Tracking Procedures – Active Contours – Shape Models And Shape Recognition – Centroidal Profiles – Handling Occlusion – Boundary Length Measures – Boundary Descriptors – Chain Codes – Fourier Descriptors – Region Descriptors – Moments

UNIT III HOUGH TRANSFORM

9

Line Detection – Hough Transform (HT) For Line Detection – Foot-of-Normal Method – Line Localization – Line Fitting – RANSAC For Straight Line Detection – HT
{PAGE }

Based Circular Object Detection – Accurate Center Location – Speed Problem – Ellipse Detection – Case Study: Human Iris Location – Hole Detection – Generalized Hough Transform – Spatial Matched Filtering – GHT For Ellipse Detection – Object Location – GHT For Feature Collation

UNIT IV 3D VISION AND MOTION

9

Methods For 3D Vision – Projection Schemes – Shape From Shading – Photometric Stereo –Shape From Texture – Shape From Focus – Active Range Finding – Surface Representations –Point-Based Representation – Volumetric Representations – 3D Object Recognition – 3D Reconstruction – Introduction To Motion – Triangulation – Bundle Adjustment – Translational Alignment – Parametric Motion – Spline-Based Motion – Optical Flow – Layered Motion

UNIT V APPLICATIONS

9

Application: Content Based Image Retrieval, Content Based Video Retrieval.
Case Study: Face Recognition, Gait Recognition.

TOTAL: 45 Hours

H. Learning Resources

i) Text Books:

1. E. R. Davies, (2012), "Computer & Machine Vision", Fourth Edition, Academic Press.
2. R. Szeliski, (2011) "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, (2012) "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
4. Mark Nixon and Alberto S. Aquado, (2012) "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press.

ii) Reference Books:

1. D. L. Baggio et al., (2012) "Mastering Open CV with Practical Computer Vision Projects", Packet Publishing,
2. Jan Erik Solem, (2012) "Programming Computer Vision with Python: Tools and algorithms for analyzing images", O'Reilly Media.

iii) Online Resources:

1. <http://kercd.free.fr/linksKCD.html>
2. <http://www.cs.ubc.ca/spider/lowe/vision.html>

3. {HYPERLINK "http://www.visionscience.com/"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS114	UNIX INTERNALS	3	0	0	3

Course Category: Program Elective

A. Preamble:

UNIX is a computer Operating System which is capable of handling activities from multiple users at the same time. Knowledge of UNIX Internals helps in understanding similar systems (for example, NT, LINUX) & designing high performance UNIX applications

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS110	Computer Organization and Architecture
2	1151CS108	Operating System

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS118	Distributed and Parallel Computing

D. Course Educational Objectives:

Students undergoing this course are exposed to

- Get thorough understanding of the kernel.
- Understand the file organization and management.
- Enhance knowledge about various system calls.
- Have knowledge of process architecture, process control & scheduling and memory management.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain the basic concepts of UNIX Operating System .	K2
CO2	Explain the operational concepts of Buffer, Inode	K2
CO3	Discuss the various operations of File concepts.	K2

CO4	Describe the various aspects of Process Control.											K2
CO5	Apply various Scheduling techniques for a given situations.											K3

F. Correlation of Cos with Pos:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M												L		
CO2	M				M			M					L		L
CO3	M	M			M			H		M	L		L	L	L
CO4	M	M			M			H		M	L		L	M	L
CO5	M	H			M			H		M	L		L	M	M

H- High; M-Medium; L-L

G. Course Content:

UNIT I Introduction to UNIX

9

History, need of change, Standards The process and the kernel: Mode, space and context, Process abstraction, executing in kernel mode, synchronization by blocking interrupts, process scheduling, signals, process creation, termination, awaiting process termination, zombie processes

UNIT II Buffer and Inode

9

The Buffer Cache-Headers-Buffer Pool-Buffer Retrieval-Reading and Writing Disk Blocks – Advantages and Disadvantages. Internal Representation of Files-Inodes-Structure-Directories-Path Name to Inode- Super Block-Inode Assignment-Allocation of Disk Blocks –Other File Types.

UNIT III File System Interface and Framework

9

The user interface to files, File systems, Special files, File system framework, The Vnode/Vfs architecture, Implementation Overview, File System dependent objects, Mounting a file system, Operations on files.

UNIT IV Inter Process Communication

9

Process Tracing – System V IPC – Network Communications – Sockets – Messages – Message Data Structures – Message Passing Interface – Ports – Name Space – Data Structures – Port Translations – Message Passing Process Scheduling and Time: Process scheduling – System calls for Time – Clock – Scheduler goals – Process priorities – Scheduler Implementation – Run Queue Manipulation – The SVR4 Scheduler; Memory Management Policies: Swapping – Demand Paging – A Hybrid System with swapping and demand paging

UNIT V UNIX Tools and Programming**9**

Shell programming – UNIX commands – Text processing – sed and awk utilities – grep utility – Introduction to Lex, Yacc utilities – Introduction to Perl programming.

Total: 45 hours**H. Learning Resources****i.TEXTBOOK:**

1. Maurice J. Bach, "The Design of the Unix Operating System", Pearson Education,2002.

ii.REFERENCES

1. UreshVahalia, "UNIX Internals: The New Frontiers", Prentice Hall, 2000.
2. John Lion, "Lion's Commentary on UNIX", 6th edition, Peer-to-Peer Communications, 2004.
- xii. Daniel P. Bovet & Marco Cesati, "Understanding the Linux Kernel", O'REILLY, Shroff Publishers &Distributors Pvt. Ltd, 2000.

iii. Online resources{HYPERLINK "<http://www.annaunivedu.in/2013/01/cs2028-unix-internals-syllabus->"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS115	INFORMATION AND CODING THEORY	3	0	0	3

A. Preamble :

Information produced in many ways every day such as text, image, video etc. If directly stored as it received makes the security in question mark also it occupies more storage area. This course discusses about the various forms of information and its storage methods.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS104	Digital Electronics

C. Related Courses:

Sl No	Course Code	Course Name
1	1152CS111	Multimedia Systems

D. Course Educational Objectives :

Students undergoing this course are expected to:

- Understand the basics of information theory and coding theories.
- Introduce the concept of amount of information, entropy, channel capacity, error-detection and error-correction codes, block coding, convolution coding, and Viterbi decoding algorithm.
- Understand and explain the basic concepts of information theory, source coding, channel and channel capacity, channel coding and relation among them.
- Describe the real life applications based on the fundamental theory.
- Calculate entropy, channel capacity, bit error rate, code rate, and steady-state probability and so on.
- Implement the encoder and decoder of one block code or convolution code using any program language.

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the basics of information and coding theories.	K2
CO2	Discuss the various capacity reduction based	K2

	coding techniques for text, audio and speech type of data.	
CO3	Compare various capacity reduction based coding techniques for image and video type of data.	K2
CO4	Illustrate various security oriented coding techniques for Block codes.	K2
CO5	Implement various error control techniques for Convolutional codes	K3

F. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M		L								L	M		
CO2	H	L	M										M		
CO3	H	L	M						L				H		
CO4	H	L	M	L				L	L		L	L	M	M	
CO5	H	L	M	L				L	L		L	L	M	M	L

3- High; 2-Medium; 1-Low

G. Course Content :

UNIT I INFORMATION THEORY

9

Information – Entropy, Information rate, classification of codes, Kraft McMillan inequality, Source coding theorem, Shannon-Fano coding, Huffman coding, Extended Huffman coding – Joint and conditional entropies, Mutual information – Discrete memoryless channels – BSC, BEC – Channel capacity, Shannon limit.

UNIT II SOURCE CODING: TEXT, AUDIO AND SPEECH

9

Text: Adaptive Huffman Coding, Arithmetic Coding, LZW algorithm – Audio: Perceptual coding, Masking techniques, Psychoacoustic model, MEG Audio layers I,II,III, Dolby AC3 – Speech: Channel Vocoder, Linear Predictive Coding

UNIT III SOURCE CODING: IMAGE AND VIDEO

9

Image and Video Formats – GIF, TIFF, SIF, CIF, QCIF – Image compression: READ, JPEG – Video Compression: Principles-I,B,P frames, Motion estimation, Motion compensation, H.261, MPEG standard

UNIT IV ERROR CONTROL CODING: BLOCK CODES

9

Definitions and Principles: Hamming weight, Hamming distance, Minimum distance decoding – Single parity codes, Hamming codes, Repetition codes – Linear block codes, Cyclic codes – Syndrome calculation, Encoder and decoder – CRC

UNIT V ERROR CONTROL CODING: CONVOLUTIONAL CODES

9

Convolutional codes – code tree, trellis, state diagram – Encoding – Decoding: Sequential search and Viterbi algorithm – Principle of Turbo coding

Total : 45 Hours

H. Learning Resources

i.Text Books :

1. R Bose, "Information Theory, Coding and Cryptography", TMH 2007
2. Fred Halsall, "Multimedia Communications: Applications, Networks, Protocols and Standards", Pearson Education Asia, 2002

ii. References Books:

1. K Sayood, "Introduction to Data Compression" 3/e, Elsevier 2006
2. S Gravano, "Introduction to Error Control Codes", Oxford University Press 2007
3. Amitabha Bhattacharya, "Digital Communication", TMH 2006

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS116	INFORMATION RETRIEVAL AND STORAGE MANAGEMENT	3	0	0	3

Course Category: Program Elective

A. Preamble:

Information Storage and Retrieval have highly developed into a sophisticated pillar of information technology, provides a variety of solutions for storing, managing, accessing, protecting, securing, sharing, retrieving and optimizing information.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS107	Data Base Management System
2	1151CS114	Data Warehousing and Data Mining

C. Related Courses:

Sl. No	Course Code	Course Name
01	1152CS120	Cloud Computing

D. Course Educational Objectives:

The Student should be made to

1. Identify the components of managing the data center and Understand logical and physical components of a storage infrastructure.
2. Evaluate storage architectures, including storage subsystems SAN, NAS, IPSAN, CAS
3. Understand the securing framework and managing storage infrastructure.
4. Understand the information retrieval models
5. Learn about document and text mining techniques.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basic concepts of storage systems	K2
CO2	Discuss and develop the storage system using network	K2
CO3	Summarize the security framework and storage infrastructure management	K2
CO4	Explain various information retrieval models.	K2
CO5	Apply document and text mining techniques.	K3

F. Correlation of Cos with Pos:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1															
CO2	L		M	M					M						L
CO3			M	L	M			H	M		L			M	L
CO4	L		M		H			H	M		H		M	M	L
CO5	L		M		H			H	M		H		M	M	M

H- High; M-Medium; L-Low

G. Course Content:

UNIT I INTRODUCTION TO STORAGE

9

Introduction to Information Storage Management – Data Centre Environment– Database Management System (DBMS) – Host – Connectivity –Storage-Disk Drive Components- Intelligent Storage System –Components of an Intelligent Storage System- Storage Provisioning- Types of Intelligent Storage Systems

UNIT II STORAGE NETWORKING

9

Fibre Channel: Overview – SAN and Its Evolution –Components of FC SAN –FC Connectivity-FC Architecture- IPSAN-FCOE-FCIP-Network-Attached Storage General-Purpose Servers versus NAS Devices – Benefits of NAS- File Systems and Network File Sharing-Components of NAS – NAS I/O Operation –NAS Implementations –NAS File-Sharing Protocols-Object-Based Storage Devices Content-Addressed Storage –CAS Use Cases.

UNIT III SECURING AND MANAGING STORAGE INFRASTRUCTURE 9
Information Security Framework –Storage Security Domains-Security Implementations in Storage Networking – Monitoring the Storage Infrastructure – Storage Infrastructure Management Activities –Storage Infrastructure Management Challenges.

UNIT IV INFORMATION RETRIEVAL 9
Boolean and vector-space retrieval models- Term weighting – TF-IDF weighting- cosine similarity – Preprocessing – Inverted indices – efficient processing with sparse vectors – Language Model based IR – Probabilistic IR –Latent Semantic Indexing – Relevance feedback and query expansion.

UNIT V DOCUMENT TEXT MINING 9
Information filtering; organization and relevance feedback – Text Mining –Text classification and clustering – Categorization algorithms: naive Bayes; decision trees; and nearest neighbor – Clustering algorithms: agglomerative clustering; k-means; expectation maximization (EM).

TOTAL: 45 Hours

H. Learning Resources

i.TEXT BOOKS:

1. EMC Corporation “Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments”, John Wiley & Sons, 30-Apr-2012
2. {HYPERLINK
"<https://www.google.co.in/search?tbo=p&tbs=bks&q=inauthor:%22Richard+Barber%22>"}, {HYPERLINK
"<https://www.google.co.in/search?tbo=p&tbs=bks&q=inauthor:%22Paul+Massiglia%22>"}, Storage Area Network Essentials: A Complete Guide to Understanding and Implementing SANs”, John Wiley & Sons, Nov-2002
3. Massimo Melucci, “Introduction to Information Retrieval and Quantum Mechanics”, Springer, 08-Dec-2015

1. Reference Books:

1. Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill, Osborne, 2003.
2. Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne, 2nd Edition, 2001.
3. Meeta Gupta, “Storage Area Network Fundamentals”, Pearson Education Limited, 2002.
4. Michael W. Berry, “Survey of Text Mining: Clustering, Classification, and Retrieval”, Springer Science & Business Media, 14-Mar-2013

xiii. Online resources

1. {HYPERLINK "http://www.infoplease.com/encyclopedia/science/information-storage-retrieval.html"}
2. {HYPERLINK "http://whatis.techtarget.com/definition/ISRS-information-storage-and-retrieval-system"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS117	INFORMATION SECURITY	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course helps to study the critical need for ensuring Information Security in Organizations

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and Network Security

D. Course Educational Objectives :

Learners are exposed to

- understand the basics of Information Security
- know the legal, ethical and professional issues in Information Security
- know the aspects of risk management
- become aware of various standards in this area
- know the technological aspects of Information Security

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the basics of information security	K2
CO2	Illustrate the legal, ethical and professional issues in information security	K2
CO3	Demonstrate the aspects of risk management.	K2
CO4	Summarize various standards in Information Security System	K2
CO5	Explain the Security Techniques	K2

F. Correlation of Cos with Program outcomes and Programme Specific Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M					M		L							
CO2	M					M		H		M		M			
CO3	L					M	L	L	M		M	L			M
CO4	L					M		L							
CO5	L	L	L		L	M		L		M		M	L	L	

H- High; M-Medium; L-Low

G. Course Content:

UNIT I – INTRODUCTION

9

History of Information Security- Critical Characteristics of Information, NSTISSL Security Model, Components of an Information System, Securing the Components, Balancing Security and Access, The SDLC, The Security SDLC

UNIT II – SECURITY INVESTIGATION

9

Need for Security, Business Needs, Threats, Attacks, Legal, Ethical and Professional Issues

UNIT III – SECURITY ANALYSIS

9

Risk Management: Identifying and Assessing Risk, Assessing and Controlling Risk

UNIT IV – LOGICAL DESIGN

9

Blueprint for Security, Information Security Policy, Standards and Practices, ISO 17799/BS 7799, NIST Models, VISA International Security Model, Design of Security Architecture, Planning for Continuity

UNIT V – PHYSICAL DESIGN

9

Security Technology, IDS, Scanning and Analysis Tools, Cryptography, Access Control Devices, Physical Security, Security and Personnel

TOTAL: 45 Hours

H. Learning Resources

i.Text Books:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security",
Vikas
Publishing House, New Delhi, 2003

xiv. Reference Books:

1. Micki Krause, Harold F. Tipton, " Handbook of Information Security Management",
Vol 1-3 CRC Press LLC, 2004.
2. Stuart Mc Clure, Joel Scrambray, George Kurtz, "Hacking Exposed", Tata McGraw-Hill, 200.
3. Matt Bishop, " Computer Security Art and Science", Pearson/PHI, 2002.

Iii Onlineresources

1. <http://cscourseonline.com/wp-content/uploads/2015/05/information-security-and-CL-unit-1.pdf>.
- xv. {HYPERLINK "<http://www.cs.iit.edu/~cs549/slides/chapter-1.pdf>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS118	DISTRIBUTED AND PARALLEL COMPUTING	3	0	0	3

Course Category: Program Elective

A. Preamble:

Data from various sources saved in different location in a distributed manner. Handling this distribution need incorporation of different technologies for transferring, receiving and processing of these data are parallelized with high efficiency computing

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS108	Operating System
2	1151CS111	Computer Networks

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Describe the basics of Hardware Infrastructure	K2
CO2	Explain the concept of software architecture	K2
CO3	Describe the basic concepts of Parallel Computing	K2
CO4	Discuss the memory devices in Parallel Computing	K2
CO5	Explain the modeling of program performance	K2

E. Correlation of Cos with Pos:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		L		L								L		
CO2	M		L		M									M	
CO3	M		M		M									M	
CO4	M				M										L
CO5	M		M		M									M	M

F. Course Content:

UNIT I Hardware Infrastructure

9

Broad Band Transmission Facilities – Open Interconnection Standards – Local Area Networks – Wide Area Networks – Network Management – Network Security.

UNIT II Software Architectures

9

Client – Server Architectures – Intranets and Groupware – Hardware and Software for Intranet – Groupware and Features – Network as a Computer – The Internet – IP Addressing – Internet Security

UNIT III Introduction to Parallel Computing

9

Principles of parallel algorithm design – decomposition techniques – mapping & scheduling computation – templates – Programming shared-address space systems – Cilk Plus – OpenMP- Pthreads

UNIT IV Handling Memory in Parallel Computing

9

Parallel computer architectures – shared memory systems and cache coherence – distributed-memory systems – interconnection networks and routing

UNIT V Parallel Programming

9

Programming scalable systems – message passing: MPI – global address space languages – Analytical modeling of program performance – speedup, efficiency, scalability, cost optimality, ISO efficiency

G. Learning Resources

i. Text Books:

1. Albert Fleishman, Distributed Systems – Software Design & Implementation, Springer-Verlag, 1994.
2. Introduction to Parallel Computing, Second Edition, Ananth Grama, George Karypis, Vipin Kumar, Anshul Gupta, Addison-Wesley, 2003, ISBN: 0201648652

i. Reference:

1. Mukesh Singal and Shivaratu N.G., Advanced Concepts in Operating Systems, McGraw Hill, Newyork 1994.
2. George Coulouris and Jean Dollimore, Distributed Systems – Concepts and Design, Addison-Wesley, 1988.
3. Parallel Programming in C with MPI and OpenMP by M J Quinn
4. Introduction to Parallel Computing by Ananth Grama, George Karypis, Vipin Kumar, and Anshul Gupta.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS119	PYTHON PROGRAMMING	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course focused on constructing reasonably self-contained programs, where the input and output either comes from a user or from files and any “external” functionality comes from imported Python modules.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Link to Other Courses:

Sl. No	Course Code	Course Name
1	1151CS115	Computer Graphics and Image Processing
2	1151CS111	Computer Networks
3	1152CS101	Cryptography and Network Security

D. Course Educational Objectives:

Students undergoing this course are exposed to

- Introduces core programming basics—including data types, control structures, algorithm development, and program design with functions
- Course discusses the fundamental principles of Object-Oriented Programming, as well as in-depth data and information processing techniques
- Students will solve problems, explore real-world software development challenges, and create practical and contemporary applications.

E. Course Outcomes:

Students undergoing this course are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain various operators used in python.	K2
CO2	Apply the string handling functions to solve the given problem	K3
CO3	Describe Object oriented concepts with python	K2
CO4	Use image processing techniques in python programming to solve a given problem	K3
CO5	Discuss the functions of networking in python	K3

K2-Understand, K3-Apply

F. Correlation of Cos with Program Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M														
CO2	M	M	L	L					L		L	L			
CO3	M	L			L								M		
CO4	M	M	M	M	L				L		L	M	M	M	M
CO5	M	M	M	L	L			L		L		L	M	M	M

H- High; M-Medium; L-Low

G.Syllabus Content:

UNIT I INTRODUCTION

9

installing Python; basic syntax, interactive shell, editing, saving, and running a script-variables, assignments; immutable variables; numerical types; arithmetic operators and expressions; comments in the program; understanding error messages;

UNIT II CONDITIONAL STATEMENT & STRING HANDLING

9

Conditions, Boolean logic, logical operators; ranges; Control statements: if-else, loops (for, while); short-circuit (lazy) evaluation – Manipulating files and directories, os and sys modules; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated). String manipulations: subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa. Binary, octal, hexadecimal numbers.

UNIT III OBJECT ORIENTED PROGRAMMING WITH PYTHON 9
Classes and OOP: classes, objects, attributes and methods; defining classes; design with classes, data modeling; persistent storage of objects – OOP, continued: inheritance, polymorphism, operator overloading; abstract classes; exception handling, try block

UNIT IV IMAGE PROCESSINGWITH PYTHON 9
Design with functions: hiding redundancy, complexity; arguments and return values; formal vs actual arguments, named arguments. Program structure and design. Recursive functions-Simple Graphics and Image Processing: “turtle” module; simple 2d drawing – colors, shapes; digital images, image file formats, image processing Simple image manipulations with ‘image’ module (convert to b/w, 153rayscale, blur, etc).

UNIT V NETWORKINGWITH PYTHON 9
Multithreading, Networks, and Client/Server Programming; introduction to HTML, interacting with remote HTML server, running html-based queries, downloading pages; CGI programming, programming a simple CGI form.

Total: 45 HOURS

H.Learning Resources

i. Text Book:

1. “Learning Python: Powerful Object-Oriented Programming: 5th Edition Shroff; Fifth edition (24 July 2013)

ii. Reference Books

1. “Python Essential Reference”. Addison-Wesley Professional; 4 edition (July 19, 2009) by David M.Baezly
2. “Python Cookbook” O'Reilly Media; 3 edition (June 1, 2013) by David M. Baezly.

iii. Online Resources:

1. {HYPERLINK "https://www.codecademy.com/learn/python"}
2. {HYPERLINK "http://www.learnpython.org/"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS120	CLOUD COMPUTING	3	0	0	3

Course Category: Program Elective

A. Preamble :

Cloud computing is an emerging computing paradigm where various users access the resources and services offered by service providers. Use of cloud computing at this course encompasses the production services and it can offer benefits in the cost, performance, and delivery of IT services. The use of cloud computing services is forecast to grow significantly over the coming years.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1151CS103	Programming in Java
3	1151CS117	Java Programming

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and Network Security

D. Course Educational Objectives :

Students undergoing this course are expected to gain:

- To access cloud resources and services needed to perform functions with dynamically changing needs.
- To understand the cloud privacy and security concepts to create secure cloud environment.
- To learn the various cloud platforms to implement real time cloud applications.

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Outline the various cloud service delivery and deployment models.	K2
CO2	Interpret the role of virtualization in cloud environment.	K2
CO3	Explain the various private cloud deployment models.	K2

CO4	Explain the cloud service working models in public cloud environment.											K2		
CO5	Relate the cloud security with traditional security to adapts the future trends of Cloud Computing											K2		

F. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L		L								L	L	
CO2	M	M	L	L	M		L		L				M	M	
CO3		L	M	M	M	M	M		L			L		M	
CO4		M	M	M	M	M	M		M			L		M	M
CO5		L	L		M	M		M				M		M	M

G. Course Content:

Unit I: Overview of Cloud Computing

9

Brief history and evolution - History of Cloud Computing, Evolution of Cloud Computing, Traditional vs. Cloud Computing. Why Cloud Computing, Cloud service models (IaaS, PaaS & SaaS). Cloud deployment models (Public, Private, Hybrid and Community Cloud), Benefits and Challenges of Cloud Computing. Introduction to AWS Public Cloud Vendor.

Unit II: Virtualization

9

Basics of virtualization, Server virtualization, VM migration techniques, Role of virtualization in Cloud Computing.

Unit III: Working with Private Cloud

9

Private Cloud Definition, Characteristics of Private Cloud, Private Cloud deployment models, Private Cloud Vendors - CloudStack, Eucalyptus and Microsoft, Private Cloud – Benefits and Challenges. Private Cloud implementation in Amazon EC2 service.

Unit IV: Working with Public Clouds

9

What is Public Cloud, Why Public Cloud, When to opt for Public Cloud, Public Cloud Service Models, and Public Cloud Vendors and offerings (IaaS, PaaS, SaaS). Demonstrating public cloud with AWS, Introduction to EC2 and Storage services of AWS. Private vs. Public Cloud – When to choose.

Unit V: Overview of Cloud Security and Future directions in Cloud Computing

9

Explain the security concerns in Traditional IT, Introduce challenges in Cloud Computing in terms of Application Security, Server Security, and Network Security. Security reference model, Abuse and Nefarious Use of Cloud Computing, Insecure Interfaces and APIs, Malicious Insiders, Shared Technology Issues, Data Loss or Leakage, Account or Service Hijacking, Unknown Risk Profile, Shared security model

between vendor and customer in IAAS/PAAS/SAAS, Implementing security in AWS. When and not to migrate to Cloud, Migration paths for cloud, Selection criteria for cloud deployment, Issues/risks in cloud computing, Future technology trends in Cloud Computing.

TOTAL: 45 Hours

H. Learning Resources

Text Book

1. Rajkumar Buyya, James Broberg, Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", Wiley, 1st Edition, 2013. ISBN-10: 9788126541256, ISBN-13: 978-8126541256.
2. Michael Miller, "Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online", QUE, 1st Edition, 2008. ISBN-10: 9780789738035, ISBN-13: 978-0789738035.
3. Judith S. Hurwitz, Robin Bloor, Marcia Kaufman, Fern Halper, "Cloud Computing For Dummies", For Dummies, 1st Edition, 2010.
4. Toby Velte, Anthony Velte, Robert C. Elsenpeter, "Cloud Computing-A Practical Approach", McGraw-Hill Education, 1st Edition, 2009. ISBN-10: 0071626948, ISBN-13: 978-0071626941.
5. Borko Furht, Armando Escalante, "Handbook of Cloud Computing", Springer, 2010th Edition, 2010. ISBN-10: 1441965238, ISBN-13: 978-1441965233.

Reference Book

1. John W. Rittinghouse, James F. Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 1st Edition, 2009. ISBN-10: 9781439806807, ISBN-13: 978-1439806807.
2. Barrie Sosinsky, "Cloud Computing Bible", Wiley, First Edition, 2011. ISBN-10: 8126529806, ISBN-13: 978-8126529803.
3. John Rhoton, Risto Haukioja, "Cloud Computing Architected: Solution Design Handbook", Recursive, Limited, 2011. ISBN-10: 0956355617, ISBN-13: 978-0956355614.
4. Ronald L. Krutz, Russell Dean Vines, "Cloud Security: A Comprehensive Guide to Secure Cloud Computing", Wiley, 1st Edition, 2010. ISBN-10: 0470589876, ISBN-13: 978-0470589878.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS121	BIG DATA AND ANALYTICS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course covers foundational techniques and tools required for data science and big data analytics. The course focuses on concepts, principles, and techniques applicable to any technology environment and industry and establishes a baseline that can be enhanced by further formal training and additional real-world experience.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS108	Operating System
2	1152CS119	Python Programming
3	1151CS117	{HYPERLINK \l "jp"}

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS118	Distributed and Parallel Computing

D. Course Educational Objectives:

Learners are exposed to

- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Differentiate traditional data processing with Big Data Analytics.	K2
CO2	Explain the technology landscape behind the Big Data Analytics using Hadoop and NoSQL	K2
CO3	Solve distributed computing challenges with the help of Hadoop and MongoDB.	K3

CO4	Perform CRUD operations using Cassandra and Hive	K3
CO5	Differentiate between Pig and Hive in terms of processing and to design JasperReports using Jaspersoft studio using data from NoSQL databases.	K3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M														
CO2	M	M			M										
CO3	M	M			M						M				L
CO4	M	M			M						L				
CO5	M	H			H										

H- High; M-Medium; L-Low

G. Course Content:

UNIT 1 Introduction to Digital Data and Big Data

7

Types of Digital Data:

Classification of Digital Data- Structured Data: Sources of Structured Data, Ease of Working with Structured Data- Semi-Structured Data: Sources of Semi-Structured Data- Unstructured Data: Issues with Unstructured Data, How to Deal with Unstructured Data.

Introduction to Big Data:

Characteristics of Data- Evolution of Big Data- Definition of Big Data: Volume, Velocity, Variety - Challenges of Big Data- What is Big Data?- Other Characteristics of Data Which are Not Definitional Traits of Big Data- Why Big Data?- Are We Just an Information Consumer or Do We Also Produce Information- Traditional Business Intelligence (BI) versus Big Data- A Typical Data Warehouse Environment- A Typical Hadoop Environment- What is Changing in the Realms of Big Data?- What is New Today?: Coexistence of Big Data and Data Warehouse.

UNIT 2 Introduction to Big Data Analytics and Technology landscape

8

Introduction to Big Data Analytics:

Where do we Begin?- What is Big Data Analytics?- What Big Data Analytics isn't?- Why this Sudden Hype around Big Data Analytics?- Classification of Analytics, Greatest Challenges that Prevent Businesses from Capitalizing on Big Data- Top Challenges Facing Big Data- Why is Big Data Analytics Important?- What Kind of Technologies are we Looking Toward to Help Meet the Challenges Posed by Big Data?- Data Science-

Data Scientist- Terminologies Used in Big Data Environment: In Memory Analytics, In Database Processing, Symmetric Multiprocessor System, Massively Parallel Processing, Difference between Parallel versus Distributed Systems, Shared Nothing Architecture, Consistency, Availability, Partition Tolerance (CAP): Theorem Explained, Basically Available Soft State Eventual Consistency (BASE)- Top Analytics Tools.

The big data technology landscape:

NoSQL: Where is it used? What is it? Types of NoSQL Databases, Why NoSQL? Advantages of NoSQL, what we miss with NoSQL? NoSQL Vendors, SQL versus NoSQL, NewSQL, Comparison of SQL, NoSQL and NewSQL. Hadoop: Features of Hadoop, Key Advantages of Hadoop, Versions of Hadoop: Hadoop 1.0- Hadoop 2.0, Overview of Hadoop Ecosystems, Hadoop Distributions, Hadoop versus SQL, Integrated Hadoop Systems Offered by Leading Market Vendors, Cloud based Hadoop solutions.

UNIT 3 Introduction to Hadoop and MongoDB

10

Introduction to Hadoop:

Introducing Hadoop: Data- The Treasure Trove- Why Hadoop? - Why not RDBMS? - RDBMS versus Hadoop- Distributed Computing Challenges: Hardware Failure, How to Process this Gigantic Store of Data? - A Brief History of Hadoop: The Origin of the Name Hadoop- Hadoop Overview: Key Aspects of Hadoop- Hadoop Component- Hadoop Conceptual Layer- High Level Architecture of Hadoop. Business Value of Hadoop: Clickstream Data - Hadoop Distributors- Hadoop Distributed File System: HDFS Daemons, Anatomy of File Read, Anatomy of File Write, Replica Placement Strategy, Working with HDFS commands, Special Features of HDFS- Processing Data with Hadoop: MapReduce Daemons, how does MapReduce work? MapReduce Example- Managing Resources and Application with Hadoop YARN: Limitations of Hadoop 1.0 Architecture, HDFS Limitation, Hadoop 2: HDFS, Hadoop 2 YARN: Taking Hadoop Beyond Batch- Hadoop Ecosystem: Pig, Hive, Sqoop, HBase.

Introduction to MongoDB:

What is MongoDB?- Why MongoDB? : Using JSON, Creating or Generating a Unique Key, Support for Dynamic Queries, Storing Binary Data, Replication, Sharding, Updating Information In-Place - Terms used in RDBMS and MongoDB - Data Types in MongoDB – CRUD(Create, Read, Update and Delete): Insert(), Update(), Save(), Remove(), find() – Arrays- MapReduce Functions- Aggregation- Java Scripting- Cursor- Index- MongoImport- MongoExport- Automatic generation of unique numbers for the “_id” field.

UNIT 4 Introduction to Cassandra and Hive

10

Introduction to Cassandra:

Apache Cassandra : An Introduction- Features of Cassandra: Peer-to-Peer Network, Gossip and Failure Detection, Partitioner, Replication Factor, Anti-Entropy and Read Repair, Writes in Cassandra, Hinted Handoffs, Tunable Consistency: Read Consistency and Write Consistency- CQL Data Types- CQLSH- Key spaces- CRUD: Insert, Update, Delete, Select -Collections: Set, List, Map- Using a Counter -Time To Live (TTL)- Alter: Alter Table to Change the Data Type of a Column, Alter Table to Delete a Column, Drop a Table, Drop a Database- Import and Export: Export to CSV, Import from CSV, Import from STDIN, Export to STDOUT -System Tables- Practice Examples.

Introduction to Hive:

What is Hive?: History of Hive and Recent Releases of Hive, Hive Features, Hive Integration and Work Flow, Hive Data Unit - Hive Architecture - Hive Data Types: Primitive Data Types, Collection Data Types - Hive File Format: Text File, Sequential File, RCFile (Record Columnar File)- Hive Query Language: DDL (Data Definition Language) Statements, DML (Data Manipulation Language) Statements, Starting Hive Shell, Database, Tables, Partitions, Buckets, Views, Sub Query, Joins, Aggregation, Group BY and Having, RCFIIE Implementation, SERDE, UDF.

UNIT 5 Introduction to Pig and Jasper Report

L-10

Introduction to Pig:

What is Pig?: Key Features of Pig - The Anatomy of Pig - Pig on Hadoop - Pig Philosophy - Use Case for Pig: ETL Processing - Pig Latin Overview: Pig Latin: Statements, Pig Latin: Keywords, Pig Latin: Identifiers, Pig Latin: Comments, Pig Latin: Case Sensitivity- Data Types in Pig: Simple Data Types, Complex Data Types- Running Pig: Interactive Mode, Batch Mode- Execution Modes of Pig: Local Mode, Map Reduce Mode- HDFS Commands- Relational Operators- Eval Function- Complex Data Type: Tuple, Map - Piggy Bank- UDF (User Defined Function)- Parameter Substitution- Diagnostic Operator- Word Count Example- When to use Pig?- When NOT to use Pig?- Pig at Yahoo - Pig versus Hive- Hive Vs Pig.

Jasper Report using Jasper Soft:

Introduction to JasperReports, Jaspersoft Studio: JasperReports, Jaspersoft Studio - Connecting to MongoDB NoSQL database: Syntax of Few MongoDB Query Language, Elements and Attributes, Creating Variables, Creating Report Parameters- Connecting to Cassandra NoSQL Databases.

TOTAL: 45 periods

H. Learning Resources

i) Text Books

1. Seema Acharya and Subhashini C: Big Data and Analytics, First Edition, Wiley India Pvt. Ltd, 2015.
2. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman: Big data for dummies – Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, Wiley India Pvt. Ltd, April 2013.
3. Tom White: Hadoop: The Definitive Guide, O'Reilly Media 4th Edition, March 2015.
4. Chuck Lam: Hadoop in action, Manning Publications Co, 2011
5. Dirk Deroos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown: Hadoop for dummies, Wiley publications, 2014.

ii) Reference Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012
4. Big Data: A Revolution That Will Transform How We Live, Work, and Think by Viktor Mayer-Schoenberger & Kenneth Cukier
5. MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems

iii) Web References

1. www.iannauniversity.com/.../it2024-user-interface-design-u...
2. www.cramster.com › ... › software design › resource › lecture note
3. www.aw-bc.com/DTUI3/lecnotes.doc.
4. <https://www.cosc.brocku.ca/~bockusd/3p94/webui1.pdf>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS122	VIRTUALIZATION TECHNOLOGIES	3	0	0	3

Course Category: Program Elective

A. Preamble:

Many times, computer storage is not utilized properly. Basically, for some application needs more space but the available space may be less or vice versa. For proper and better utilization of need to go for the concept called virtualization. This course goes in deep concept behind virtualization.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are exposed to

- Computing Virtualization tools, applications and techniques
- Network Virtualization
- Virtualization and Cloud Computing

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Illustrate the basic functions and operations of Virtualization.	K2
CO2	Explain the concepts of hardware and server virtualization.	K2
CO3	Outline the different network virtualization and layer architecture.	K2

CO4	Classify the different virtualization storage architecture.	K2
CO5	Analysis the various types of virtual machines products.	K3

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO 2	PSO 3
CO1	M		M	L	L		M					M			L
CO2	M	L	M	M	L		M	L				M			L
CO3	H	L	H	M	L		M	L				M	L		L
CO4	H	L	M	L	L		M	L				M	L		L
CO5	H	L	L	L	L		M	L				M	L	L	L

G. Course Content:

UNIT I OVERVIEW OF VIRTUALIZATION 10

Basics of Virtualization - Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-level or Operating Virtualization – Application Virtualization-Virtualization Advantages – Virtual Machine Basics – Taxonomy of Virtual machines - Process Virtual Machines – System Virtual Machines – Hypervisor - Key Concepts

UNIT II SERVER CONSOLIDATION 8

Hardware Virtualization – Virtual Hardware Overview - Sever Virtualization – Physical and Logical Partitioning - Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation – Planning for Development – Selecting server Virtualization Platform.

UNIT III NETWORK VIRTUALIZATION 10

Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design – WAN Architecture - WAN Virtualization - Virtual Enterprise Transport Virtualization– VLANs and Scalability - Theory Network Device Virtualization Layer 2 - VLANs Layer 3 VRF Instances Layer 2 - VFIs Virtual Firewall Contexts Network Device Virtualization - Data- Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation – Ipsec L2TPv3 Label Switched Paths - Control-Plane Virtualization–Routing Protocols- VRF - Aware Routing Multi-Topology Routing.

UNIT IV VIRTUALIZING STORAGE 8

SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual tape libraries.

UNIT V VIRTUAL MACHINES PRODUCTS

9

Xen Virtual machine monitors - Xen API – VMware – VMware products – VMware Features – Microsoft Virtual Server – Features of Microsoft Virtual Server.

TOTAL:45Hours

H. Learning Resources

i. Text Books:

1. William von Hagen, Professional Xen Virtualization, WorxPublications, January, 2008.
2. Chris Wolf, Erick M. Halter, Virtualization: From the Desktop to the Enterprise, A Press 2005.

ii. Reference:

1. James E. Smith, Ravi Nair, Virtual Machines: Versatile Platforms for Systems and Processes, Elsevier/Morgan Kaufmann, 2005.
2. David Marshall, Wade A. Reynolds, Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center, Auerbach Publications, 2006.

iii. Online resources

1. {[HYPERLINK "http://www.cs.sunysb.edu/~chiueh/cse674/list.pdf"](http://www.cs.sunysb.edu/~chiueh/cse674/list.pdf)}
 2. {[HYPERLINK "http://www.stanford.edu/class/ee282/handouts/lect.10.vm.pdf"](http://www.stanford.edu/class/ee282/handouts/lect.10.vm.pdf)}
 3. grids.ucs.indiana.edu/ptliupages/publications/10-fg-hypervisor.pdf
- {[HYPERLINK "http://www.slideshare.net/sigindia/emc-lecture-session-virtualization-technology-and-directions-9731982"](http://www.slideshare.net/sigindia/emc-lecture-session-virtualization-technology-and-directions-9731982)}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS123	SOCIAL NETWORK ANALYSIS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course presents theoretical approaches which have been developed in other areas as a means of understanding how society functions and decisions are made.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1152CS101	Cryptography and network security

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Basics of computer networks
- Formalize different types of networks
- Plan and execute network communities.
- Network applications.
- Network Implications and cascades.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	COURSE OUTCOMES	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Outline the basic concepts of complex networks and random graphs.	K2
CO2	Illustrate the different types of real networks and	K2

	random networks.	
CO3	Summarize the network community activities.	K2
CO4	Explain about web search in social networks.	K2
CO5	Apply Network Implications and cascades behavior of social	K3

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	L					M				L	L		L
CO2	M	L	L					M	L			L	L		L
CO3	M	L	M					M	L			L	L		M
CO4	M	L	M					M	M			L	L		M
CO5	M	L	M					M	M			L	L		M

G. Course Content:

UNIT 1 Introduction to Complex Networks and Random Graphs 9

Networks – face book – terrorist network – Internet – Airline Network – Geo - Social Networks A Network is a Graph Node Degree – Directed & Undirected – Graphs Paths and Cycles Connectivity – Components – Path Length / Distance – Small – world Phenomenon – Milgram’s Experiment Erdos Number Bacon Number Random Graphs - Model – Properties Diameter.

UNIT II **9**

Small World and Weak ties- Clustering Co - efficient of Real Networks - Real Networks vs Random Networks – Small World Model-Other Real Networks Examples-Bridges - Network Centrality and Applications Centrality-Measures-Normalization-Freeman’s Network-Centrality Betweenness-Closeness-Centrality.

UNIT III **9**

Communities-Overlapping Communities and Community Detection – Communities-Edge Betweenness – Calculating number of shortest paths - Calculating flows – Modularity- Modularity Optimization.

Structure of the Web-Search and Power Laws Precursor of hypertexts-SCC-Power Law vs Exponent-Reach Ability-Unpredictability -Network Robustness and Applications-Internet as topology-Properties- Robustness Site-Percolation- effect of attacks and failure on WWW and Internet- Effect on Giant Component Scale-free networks

UNIT V**9**

Cascades and Behavior Influence – Decision Making and Behavior Influence - Model of Discussion - Network Implications- Chain Reactions Cascades – Viral Marketing – Clusters and Cascades- Epidemic Spreading – Epidemic Spreading and Information Cascades Examples.

TOTAL: 45 Hours**H. Learning Resources****i. TEXT BOOKS:**

1. D. Easley, J. Kleinberg. Networks, Crowds, and Markets: Reasoning About a Highly Connected World. Cambridge University Press, 2010.
2. M. Newman. Networks.Oxford University Press. April 2010.

ii. REFERENCE BOOKS:

1. Stanley Wasserman, University of Illinois, Urbana-Champaign, Social Network Analysis Methods and Applications, University of South Carolina, May 1995.
2. Stanley Wasserman, Joseph Galaskiewicz, Advances in Social Network Analysis: Research in the Social and Behavioral Sciences (Google eBook), SAGE Publications, 27-Jul-1994

iii. Online resources

1. <http://lrs.ed.uiuc.edu/tse-portal/analysis/social-network-analysis>
2. http://digitalcommons.usu.edu/itls_facpub/133

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS124	SOFT COMPUTING	3	0	0	3

Course Category: Program Elective

A. . Preamble: This course introduces some new fields in soft computing with its principal components of fuzzy logic, ANN, and EA, and it is hoped that it would be quite useful to study the fundamental concepts on these topics for the pursuit of allied research.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS102	Data Structures

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected to

- To introduce the ideas of fuzzy sets, fuzzy logic and use of heuristics based on human experience
- To become familiar with neural networks that can learn from available examples and generalize to form appropriate rules for inference systems
- To provide the mathematical background for carrying out the optimization associated with neural network learning
- To familiarize with genetic algorithms and other random search procedures useful while seeking global optimum in self-learning situations
- To introduce case studies utilizing the above and illustrate the intelligent behavior of programs based on soft computing

E. Course Outcomes:

Students undergoing this course are able to

CO Nos.	COURSE OUTCOMES	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Analyse a given computational task to recognize the appropriateness through fuzzy sets	K2
CO2	Design a fuzzy based soft computing system to address the computational task	K3
CO3	Analyse a given computational task to solve it through neural network	K3
CO4	Applying Genetic Algorithm operations for solving a computational task	K3
CO5	Design and implement a soft computing system to achieve a computational solution	K3

F. Mapping Course Outcomes with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M						M					L	L		L
CO2	M		H				M					M	L	L	L
CO3	M	H	L				M	L				M	L	M	L
CO4	M	L	L				M	L				M	L	M	L
CO5	M	L	L				M	L				M	M	L	L

G. Course Content

Unit-I

9

Introduction to Soft Computing, Evolution from Conventional AI to Computational intelligence and Evolutionary Search StrategiesFuzzy Sets, Fuzzy Membership Functions, Operations, Relations, Fuzzy Extension PrincipleBasics of Fuzzy Logic- Problem solving using Fuzzy Rules and Fuzzy Reasoning, Mamdani 's Representation, Zadeh's Representation

Unit-II 9

Fuzzy Inference Systems, Fuzzification, Application of Fuzzy Operators on Antecedent part of Rules, Evaluation of Fuzzy Rules, Defuzzification, Problems associated to Fuzzy controller (Cruise Controller and Air Conditioner Controller)

Unit-III 9

Neural Networks in Computer Science, Biological model, McCulloch-Pitts Model, The Perceptron Model, Widrow-Hoff's Delta Rule, XOR Problem, Curse of Dimensionality, Dimensionality Reduction, Activation Functions, Learning by Neural Nets;

Pattern Classifiers- Layered Feed Forward Neural Networks- Solution for XOR Problem, Hebb's Rule;Competitive Learning Methods (Kohonen's Self Organizing Maps and Learning Vector Quantization);Pattern Associators (Hopfield nets) ;

Back Propagation Networks: Generalized Delta Rule, Back Propagation Algorithm, Convergence of efficiency parameter, Boltzmann's Machine Learning Algorithm

Unit-IV 9

Advanced Search Strategies Natural Evolution – Chromosomes, Systematic approach of Elitism (Selection- Crossover- Mutation); Development of Genetic Algorithm, Fitness Function, Population, GA operators, parameters, Convergence

Unit-V 9

Hybrid Systems : Neuro-Fuzzy Modelling- control- Feedback control- neuro fuzzy control; Neuro-fuzzy Reinforcement Learning, Gradient Free Optimization(GA operators), Gain Scheduling;Case study: Color Recipe Prediction.

Total Hours: 45

H. Learning Resources:**i. Text Books:**

1. Samir Roy and Udit Chakraborty , "Introduction to Soft Computing: Neuro-Fuzzy and Genetic Algorithms" Pearson Education,2013

2. J.S.R. Jang, C.T.sun and E. Mizutani , "Neuro-fuzzy and Soft Computing: A computational Approach to Learning and Machine Intelligence, Pearson Education, 2004

ii. Reference Books:

1. D.E.GoldBerg, "Genetic Algorithms in Search, Optimization, and Machine Learning", Pearson Education, 2013
2. S.N.Sivanandam, S.N.Deepa, "Principles of Soft Computing", 2nd Edition, John-Wiley India, 2011
3. G.J.Klir and B.Yuan, "Fuzzy Sets and Fuzzy Logic: Theory and Applications", Second Reprint, PHI, 2000
4. J.A.Freeman and D.M.Skapura, "Neural Networks: Algorithms, Applications and Programming Techniques", Pearson Education, 2011

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS202	SOFTWARE TESTING	1	0	2	2

Course Category: Program Elective

A. Preamble :

The purpose of this course is to provide an understanding of concepts and techniques for testing software and assuring its quality.

B. Prerequisite:

Sl. No	Course Code	Course Name
1	1151CS112	Object Oriented Software Engineering

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives :

Learners are exposed to

- To Gain Knowledge in the Test Environment
- Ability to plan tests
- Ability to execute tests, design test cases, use test tools, etc
- Ability to develop testing status reports

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss about software testing, test plan and test case design	K2
CO2	Perform test case designing and documenting using open source test management tool.	K3
CO3	Illustrate the process involved in defect management for logging and tracking	K3

CO4	Demonstrate about the test data management, and the need for test automation	K3
CO5	Examine the importance of Selenium open source tool for automation testing	K3

F. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		L		L										
CO2	M	M	L		M	L									
CO3	M		M		M	L									M
CO4	M		M	L	M	L		L				L		L	M
CO5	M		M	L	M	L		L				L		L	M

H- High; M-Medium; L-Low

G. Course Content :

UNIT I:Introduction to Testing: 12

why and what:

Why is testing necessary? What is testing? Role of Tester, Testing and Quality, Overview of STLCSoftware Testing LifeCycle - V model:SDLC vs STLC, different stages in STLC, document templates generated in different phases of STLC, different levels of testing, different types of testing
Static Testing, Duration: Static techniques, reviews, walkthroughs
Basics of test design techniques: Various test categories, test design techniques for different categories of tests. Designing test cases using MS-Excel.

UNIT II: Test management 6

Documenting test plan and test case, effort estimation, configuration management, project progress management. Use of Testopia for test case documentation and test management.

UNIT III: Defect management: 6

Test Execution, logging defects, defect lifecycle, fixing / closing defects. Use of Bugzilla for logging and tracing defects.

UNIT IV:Test Data Management and Basics of Automation testing 8

Test Data Management –Overview, Why Test Data Management, Test Data Types, Need for Test Data Setup, Test Data Setup Stages, Test data management Challenges. Creating sample test data using MS-Excel

Basics of Automation testing:

Introduction to automation testing, why automation, what to automate, tools available for automation testing.

UNIT V:Basics of Automation testing using Selenium 13

Introduction to Selenium, using Selenium IDE for automation testing, using Selenium Web driver for automation testing, understanding TestNG framework with Selenium Web driver for automation testing.

Text Books:

1. Rex Black, "Managing the Testing Process" (2nd edition), John Wiley & Sons, 2004.
2. Dorothy Graham, Erik van Veenendaal, Isabel Evans, Rex Black , "Foundations of software testing", ISTQB Ceretification.

Reference Books:

1. Elfriede Dustin, Thom Garrett, Berne Gauf, "Implementing Automated Software Testing: How to Save Time and Lower Costs While Raising Quality" 1st Edition, Addison-Wesley Professional Publisher.

Online Resources:

1. {HYPERLINK "http://docs.seleniumhq.org/docs/"}
2. {HYPERLINK "http://www.seleniumhq.org/download/"}
3. Selenium-ide.xpi (latest current version)
4. Selenium-java.jar (latest current version)
5. Firebug.xpi (latest current version)
6. Firepath.xpi (latest current version)
7. IEDriverServer.exe (latest current version)
8. Jxl.jar (latest current version)

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS126	SOFTWARE QUALITY ASSURANCE	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course covers the principles of software development emphasizing processes and activities of quality assurance.

B. Prerequisite:

Sl. No	Course Code	Course Name
1	1151CS112	Object Oriented Software Engineering
2	1152CS202	Software Testing

C. Link to another Course:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

- This course introduces concepts, metrics, and models in software quality assurance.
- The course covers components of software quality assurance systems before, during, and after software development.
- It presents a framework for software quality assurance and discusses individual components in the framework such as planning, reviews, testing, configuration management, and so on.

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Classify the role of SQA Plans	K2
C02	Describe the formal inspections for maintaining the software Quality	K2

C03	Infer the Quality metrics for SQA	K2
C04	Identify the Software program Quality concepts	K3
C05	Compare the standard and certification of SQA	K2

K2 – Understand, K3 - Apply

F. Correlation of COs with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1 2	PSO 1	PSO 2	PSO 3
CO1	M													L	
CO2	M	M	L	M	L										L
CO3	M	M		M	L			L				L		L	L
CO4	M	M	L	M	L			L				L		L	L
CO5	M											L			

G. Course Content:

UNIT I FUNDAMENTALS OF SOFTWARE QUALITY ASSURANCE 9

The Role of SQA – SQA Plan – SQA considerations – SQA people – Quality Management – Software Configuration Management

UNIT II MANAGING SOFTWARE QUALITY 9

Managing Software Organizations – Managing Software Quality – Defect Prevention – Software Quality Assurance Management

UNIT III SOFTWARE QUALITY ASSURANCE METRICS 9

Software Quality – Total Quality Management (TQM) – Quality Metrics – Software Quality Metrics Analysis

UNIT IV SOFTWARE QUALITY PROGRAM 9

Software Quality Program Concepts – Establishment of a Software Quality Program – Software Quality Assurance Planning – An Overview – Purpose & Scope.

UNIT V SOFTWARE QUALITY ASSURANCE STANDARDIZATION 9

Software Standards–ISO 9000 Quality System Standards - Capability Maturity Model and the Role of SQA in Software Development Maturity – SEI CMM Level 5 – Comparison of ISO 9000 Model with SEI's CMM

H. Learning Resources

i. Text Books

1. Mordechai Ben-Menachem / Garry S Marliss, "Software Quality", Vikas Publishing House, Pvt, Ltd., New Delhi.

2. Watts S Humphrey, "Managing the Software Process", Pearson Education Inc.

ii. Reference Books

1. Gordon G Schulmeyer, "Handbook of Software Quality Assurance", Third Edition, Artech House Publishers 2007

2. Nina S Godbole, "Software Quality Assurance: Principles and Practice", Alpha Science International, Ltd, 2004

iii. Online References

1.{HYPERLINK "http://www.ou.ac.lk/science/.../277-cpu3147-software-quality-assurance"}

2.{HYPERLINK "http://www.site.uottawa.ca/~awilliam/seg3203/May02.ppt"}

3.{HYPERLINK "http://www.slideshare.net/.../sdpm-lecture-8-software-quality-assurance"}

4.ceng482.cankaya.edu.tr/.../CENG%20482_W1_publish_RLSD.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS305	ADVANCED JAVA PROGRAMMING	0	0	4	2

Course Category: Program Elective

A. Preamble:

Graduates of the Advanced Java Programming will have Java development skills necessary to be an effective team member on medium- to large-scale Java projects.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS201	Problem solving using C
2	1151CS117	Java Programming

C. Link to another Course:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected

- To learn advanced Java programming concepts like interface, threads, Swings etc.
- To develop network programs in Java
- To understand Concepts needed for distributed and multi-tier applications
- To understand issues in enterprise applications development.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Design and Develop Swing-based GUI components.	S3
CO2	Develop client/server applications using socket programming	S3
CO3	Build and retrieve the data from the database using SQL	S3
CO4	Develop distributed applications using RMI and component-based Java software using JavaBeans	S3

CO5	Develop and Implement server-side programs in the form of Servlets and enterprise applications.	S3
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F. Correlation of COs with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	L		L							M		L	L
CO2	M	L	L	L	M										L
CO3	M	M	M		M				L				M	M	
CO4	M	M	L	M	M			M	M	L				M	L
CO5	M	M	M	L	M	M	M	M	M	L	L	M	L	H	M

G. Course Content:

LIST OF EXPERIMENTS:

CYCLE – I

- | S.No. | Experiment Name |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Implementation of multithread application using Java. |
| 2 | Create a full set of UI widgets and other components, including windows, menus, buttons, checkboxes, text fields, scrollbars and scrolling lists, using Abstract Windowing Toolkit (AWT) & Swings. |
| 3 | Apply Event Handling on AWT and Swing components. |
| 4 | Implementation of Socket program for chat application. |
| 5 | Invoke the remote methods in an application using Remote Method Invocation (RMI) |
| 6 | Develop java Applet program to accept two numbers from user and output the sum, difference in the respective text boxes. |
| 7 | Servlet program to implement and demonstrate get () and post() methods (using HTTP Servlet class). |
| 8 | Session tracking for a hit count using Java Servlet. |

CYCLE – II

- | S.No. | Experiment Name |
|-------|---------------------------------------------------------------------------------------------------------------------------------|
| 1 | Establishing Communication between Applet and Servlet. |
| 2 | Create three tier application using Servlet by incorporating Java Database Connectivity inside Servlet to save data in a table. |
| 3 | Creating JSP program to implement attributes of directive tags. |
| 4 | Cookies and session management using JSP. |
| 5 | Create MVC application with Struts framework: using Servlet /JSP |

- 6 Creating Stateless and Stateful Session Beans.
- 7 EJB Application that demonstrates Entity Bean.
- 8 EJB Application that demonstrates Session Bean.

TOTAL: 60 Hours

H. Learning Resources

i.Text Books:

- 1. Elliotte Rusty Harold, "Java Network Programming", O'Reilly publishers, 2004
- 2. Ed Roman, "Mastering Enterprise Java Beans", John Wiley & Sons Inc., 2004.

ii. Reference Books:

- 1. Hortsmann& Cornell, "CORE JAVA 2 ADVANCED FEATURES, VOL II", Pearson Education, 2002.
- 2. Patrick Naughton, "COMPLETE REFERENCE: JAVA2", Tata McGraw-Hill, 2003.
- 3. Michael Morrison, The Complete IDIOT's, Guide to JAVA 2", Prentice Hall of India.

iii. Online resources

- 1. www.cs.rit.edu/~jmk/java707/lecnotes/lecnotes.html
- 2. <http://www.inf.ed.ac.uk/teaching/courses/cs2/LectureNotes/CS2Bh/APJ/apj5.pdf>
- 3. <http://ebookmaterials.blogspot.in/2011/07/advanced-programming-in-java-lecturer.html>
- 4. <http://java.sun.com>.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS128	FORENSICS AND CYBER APPLICATIONS	3	0	0	3

Course Category: Program Elective

A. Preamble:

Computer and communication technologies have become the key components to support critical infrastructure services in various sectors of our society. In an effort to share information and streamline operations, organizations are creating complex networked systems and opening their networks to customers, suppliers, and other business partners. Increasing network complexity, greater access, and a growing emphasis on the Internet have made information and network security a major concern for organizations. Students will learn different aspects of computer and cybercrime and ways in which to uncover, protect, exploit, and document digital evidence. Forensics is the application of scientifically proven methods to gather, process, interpret, and to use digital evidence to provide a conclusive description of {HYPERLINK "http://www.webopedia.com/TERM/C/cyber_crime.html"} activities. Cyber forensics also includes the act of making digital {HYPERLINK "http://www.webopedia.com/TERM/D/data.html"} suitable for inclusion into a criminal investigation.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1152CS101	Cryptography and Network Security

C.Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are familiarized to:

- Basics of Computer Networks.
- Fundamentals of Mac Protocols.
- Foundations of digital Forensics.
- Cyber Applications.
- Digital Evidence.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Describe the basic concepts of computer networks.	K2
CO2	Illustrate MAC protocol operation and MAC addressing.	K2
CO3	Summarize Principles, Preservation, Motive, and Technology of Computer Crime Digital Investigation	K2
CO4	Apply Forensic Science on Computer based Digital Investigation of Cyber applications.	K3
CO5	Explain about Digital Evidence on various Layers.	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	L	L										L		
CO2	M	M	L	L									L	L	L
CO3	M	M	L	L	M								M	L	
CO4	H	M	M	L	L	L		L					L	M	L
CO5	H	M	L	L		L		L					L	L	L

G. Course Content:

UNIT I Basics of Computer Networks

9

Protocols and Standards-OSI Model, TCP/IP Model, Network topology (Physical & logical), LAN standards, Ethernet (802.3)-Transmission media: Guided transmission media - Twisted Pair, Coaxial and Fiber-optic cables, switching techniques: Circuit switching, Packet switching and message switching-Network Hardware Components: Connectors, Repeaters, hubs, NICs, Bridges and Switches

UNIT II Fundamentals of Mac Protocols

9

Motivation for a specialized MAC, Fundamentals of MAC protocols, Sensor MAC Case Study (Protocol overview, Periodic listen and sleep operations, Schedule selection and coordination, Adaptive listening, Message passing), IEEE 802.15.4 protocol: Physical, MAC layer, naming and addressing, Assignment of MAC

addresses, Distributed assignment of locally unique addresses, content based and geographic addressing

UNIT III Foundations of digital Forensics 9

Language of Computer Crime Investigation- Digital Evidence of Courtroom-Cybercrime Law: United State Perspective, Indian Perspective, Indian IT Act, conductive Digital Investigation, Handling a Digital Crime Scene: Principles, Preservation, Modus Operandi, Motive, and Technology.

UNIT IV Cyber Applications 9

Violent Crime and Digital Evidence-Digital Evidence as Alibi- Gender Offenders on the Internet-Computer Intrusions-Cyber Stalking-Computer Basics for Digital Investigators-Applying Forensic Science to Computers

UNIT V Digital Evidence 9

Digital Evidence on Windows Systems-Digital Evidence on UNIX Systems-Digital Evidence on Mobile Devices- Intellectual Property Rights-Network Basics for Digital Investigators-Applying Forensic Science to Networks- Digital Evidence on the Internet- Digital Evidence on Physical and Data-Link Layers-Digital Evidence at the Network and Transport Layers, Security and Fraud detection in Mobile and wireless networks.

Total 45 Hours

H. Learning Resources

i. Text Books:

- 1 Digital Evidence& Computer Crime, Eoghan Casey Bs Ma Ac, ELSEVIER-Academic Press, Third Edition (2011), ISBN 13: 978-0123742681, ISBN 10 : 0123742684
2. Kurose, Ross "Computer Networking a Top Down Approach Featuring the Internet", Pearson; 6th edition (March 5, 2012), ISBN-10: 0132856204, ISBN-13: 978-0132856201

ii. Reference Books:

1. Guide to Computer Forensics & Investigation, Bill Nelson, Amelia Phillips, Christopher Steuart, Cengage Learning, Fourth Edition, ISBN 13: 978-1435498839, ISBN 10: 1435498836
 2. Ivan Stojmenovic, Handbook of Wireless Networks and Mobile Computing, Wiley India Student Edition, ISBN 978-81-265-0768-9
 3. Unix and Linux System Administration Handbook, EviNemeth, Garth Snyder, et al,
Person Publication,
- iii. Online resources**
1. <http://resources.infosecinstitute.com/computer-forensics-tools>
 2. <http://www.cybrary.it/course/computer-hacking-forensics-analyst>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS204	BUSINESS INTELLIGENCE	3	0	2	4

Course Category: Program Elective

A. Preamble:

All opening Vignettes and application cases shall be discussed for enlightening the significance of Business Intelligence

B. Prerequisite Courses:

- NIL-

C. Related Courses:

S1 No	Course Code	Course Name
1	1152CS121	Big Data and Analytics
2	1152CS110	Knowledge Based Decision Support Systems
3	1152CS131	Building Enterprise Applications

D. Course Educational Objectives:

The Course Objectives are to:

1. Introduce a managerial perspective of Business Intelligence (BI), and Analytics and Decision Support,
2. Provide introduction to three levels of analytics: descriptive, predictive and prescriptive,
3. Provide exposure to analytics techniques and their applications,
4. Introduce to specific software tools that can be used for developing applications, and
5. Provide introduction to emerging technologies that are likely to impact on the development and use BI applications.

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Outline of Business intelligence, Analytics and Decision Support	K2
CO2	Summarize the concepts of warehousing and descriptive level of analytics as business	K2
CO3	Explain the predictive level of analytics through data mining	K2

CO4	Analyze the Prescriptive level of analytics through text and web mining	K3
CO5	Describe about the data analytics and business analytics	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M				L			L							L
CO2	M	L	L		M			L	L						L
CO3	M	L	M		M			L	L	M			L		M
CO4	M	L	L		M			L	L	L			L		L
CO5	M	L	L		M			L	L	L			L		L

G. Course Content:

UnitI An Overview of Business intelligence, Analytics and Decision Support 9

Changing Business Environments and Computerized Decision Support; Framework for Business intelligence (BI); Intelligence Creation, Use, and BI Governance; Transaction Processing versus Analytic Processing; Successful BI Implementation; Analytics Overview; and Introduction to Big Data Analytics.

Unit-II Data Ware Housing 9

Data Ware Housing(DW) Definitions and Concepts;DW Process Overview, Architectures; Data Integration, and the Extraction, Transformation and Load (ETL) Processes;DW Development;DW Implementation Issues; Real Time DW; and DW Administration, Security Issues and Future Trends.

Business Reporting, Visual Analytics and Business Performance Management

Business Reporting Definitions and Concepts; Data and Information Visualization;Different Types of Charts and Graphs; Emergence of Data Visualization and Visual Analytics; Performance Dash Boards; Business Performance Management; Performance Measurement; Balanced Score Boards; and Six Sigma as a Performance Measurement System

Unit-III Data Mining 9

Data Mining (DM) Concepts and Applications; DM ProcessedMethods Software Tools; and DM Privacy Issues, Myths and Blunders.

Unit-IV Text and Web Analytics:	9
Text Analytics (TA) and Text Mining (TM) Overview; Natural Language Processing; TM Applications' Process; Sentiment Analysis; Web Mining (WM) Overview; Search Engines; Web Usage Mining (Web Analytics); and Social Analytics	

Unit-V Big Data Analytics:	9
Definition of Big Data; Fundamentals of Big Data Analytics; Big Data Technologies; Data Scientist; Big Data and Warehousing; Big Data Vendors; Big Data and Stream Analytics; and Applications of Stream Analytics.	

Business Analytics (BA) – Emerging trends and Future Impacts:	
Location-Based Analytics for Organizations; Analytics Applications for Consumers; Recommendation Engines; Web 2.0 Revolution and Online Social Networking; Cloud Computing and BI; Impacts of Analytics in Organizations –An Overview; Issues of Legality, Privacy and Ethics; and an overview of Analytics Ecosystem	

Total: 45 Hours

H. Learning Resources:

i. Text Books:

1. Ramesh Sharda, DursunDelen, Efraim Turban, et al, "Business Intelligence: A Managerial Perspective on Analytics", 3rd Ed, Pearson India EducationInc, Indian Subcontinent Reprint 2018 (ISBN 978-93-528-6271-9)

ii. Reference Books:

1. Jiawei Han and Michelinekambe, Jian Pei, "Data Mining: Concepts and Techniques ", 3rd ed. The Morgan Kaufmann Publishers.
2. Michael Steinbach, Pang-Ning Tan, and Vipin Kumar, "Introduction To Data Mining", Pearson International Edition, 2006.
3. James Allen," Natural Language Understanding", 2nd Ed., The Benjamin/Cummings Publishing Company Inc.
4. Daniel Jurafsky, James. H. Martin, " Speech and Language Processing" , 2nd Edition, Pearson Education Inc.
5. Gabe Ignatow, Rada F. Mihalcea, "An Introduction to Text Mining: Research Design, Data Collection, and Analysis",1st Edition,
6. {HYPERLINK
["https://www.amazon.com/s/ref=dp_byline_sr_book_1?ie=UTF8&text=Cheng+Xiang+Zhai&search-alias=books&field-author=ChengXiang+Zhai&sort=relevancerank"](https://www.amazon.com/s/ref=dp_byline_sr_book_1?ie=UTF8&text=Cheng+Xiang+Zhai&search-alias=books&field-author=ChengXiang+Zhai&sort=relevancerank)}, {HYPERLINK
["https://www.amazon.com/s/ref=dp_byline_sr_book_2?ie=UTF8&text=Sean+Massung&search-alias=books&field"](https://www.amazon.com/s/ref=dp_byline_sr_book_2?ie=UTF8&text=Sean+Massung&search-alias=books&field)

- author=Sean+Massung&sort=relevancerank"}, "Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining"1st Edition, ACM Book Series.
7. David Loshin, "{ HYPERLINK "https://www.amazon.com/Big-Data-Analytics-Enterprise-Integration/dp/0124173195/ref=sr_1_5?s=books&ie=UTF8&qid=1513228160&sr=1-5&keywords=big+data+Analytics" \o "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph" }

iii. Online Resources:

1. www.elegantjbi.com/Businessintelligence
2. www.perceptualedge.com/articles/Whitepapers/Common_Pitfalls.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS130	INTRODUCTION TO MAINFRAMES	3	0	0	3

Course Category: Program Elective

A. Preamble:

To learn the best practices for designing applications using Mainframe Technology

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS103	{HYPERLINK \l "JP"}ming in Java
2	1151CS117	Java Programming
3	1151CS302	Java Programming Lab
4	1151CS107	Database Management System

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected

- To understand the importance of Legacy System.
- To role of Mainframes in infrastructure of a medium to large IT organization.
- To understand the different components of Mainframe Technology.

E. Course Outcomes

Students undergoing this course are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Discuss Mainframes hardware systems. Operating systems and its functions.	K2
CO2	Describe Z-operating system and Virtual Storage.	K2
CO3	Explain the need of Job Control Language Statement and Procedures on Job Processing.	K2
CO4	Develop applications using COBOL Programming	K3
CO5	Develop Mainframe applications using COBOL-DB2 programming.	K3

F. Correlation of COs with Programme Outcomes:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M											L		
CO2	M														
CO3	M	M	L	L	M						L		L	M	M
CO4		M	M	L	H			L			M			M	M
CO5	L	M	M	L	H			L			M			M	M

H- Strong; M-Medium; L-Low

G. Course Content:

Unit I Evolution of Mainframe hardware, Mainframes OS and Terminology 9

Overview of Computer Architecture -Classification of Computers - micro, mini, mainframes and super computer - Mainframe computer - key features - benefits - Evolution of Mainframes - Different hardware systems. Operating systems on mainframes, Batch processing vs. online processing - mainframe operating system. - evolution - concepts of Address space, Buffer management - Virtual storage - paging - swapping - Dataset management in mainframes

Unit II z/OS and its features 9

Z-operating system (Z/OS) - Virtual storage - Paging process - storage Managers - Program execution modes - Address space - Multiple virtual system(MVS) , MVS address space, Z/OS address space - Dataset - sequential and partial dataset - Direct access storage device(DASD) -Access methods - Record formats - Introduction to virtual storage access methods(VSAM) - Catalog – VTOC

Unit III Introduction to JCL 9

Introduction to Job Control language - Job processing - structure of JCL statements - Various statements in JCL - JOB statement - EXEC statement - DD statement - JCL procedures and IBM utility programs.

Unit IV COBOL Programming 9

Introduction – History, evolution and Features, COBOL program Structure, steps in executing COBOL. Language Fundamentals – Divisions, sections, paragraphs, sentences and statements, character set, literals, words, figurative constants, rules for

forming user defined words, COBOL coding sheet. Data division – Data names, level numbers, PIC and VALUE clause, REDEFINES, RENAMES and USAGE clause. Procedure Division – Input / Output verbs, INITIALIZE verb, data movement verbs, arithmetic verbs, sequence control verbs. File processing – Field, physical / logical records, file, file organization (sequential, indexed and relative) and access mode, FILE-CONTROL paragraph, FILE SECTION, file operations. File handling verbs – OPEN, READ, WRITE, REWRITE, CLOSE. Table processing – Definition, declaration, accessing elements, subscript and index, SET statement, SEARCH verb, SEARCH ALL verb, comparison. Miscellaneous verbs – COPY, CALL, SORT, MERGE, STRING, UNSTRING verbs.

Unit V Overview of DB2 and Mainframe Application Development Guidelines

9

Introduction to DB2 – System Service component, Database Service component, Locking Service component, Distributed Data Facility Services component, Stored Procedure component, catalogs and optimizer. DB2 Objects and Data Types - DB2 Objects Hierarchy, Storage groups, Database, Table space, Table, Index, Clustered index, Synonyms and aliases, Views, Data Types. DB2 SQL programming – Types of SQL statements, DCL, DDL, DML, SPUFI utility. Embedded SQL programming – Host variable, DECLGEN utility, SQLCA, single/multiple row manipulation, cursors, scrollable cursors. COBOL coding standards, relation between a COBOL file handling program and JCL, Different types of ABEND codes, COBOL-DB2 program pre-compilation, DBRM (Database Request Module), Application plan/packages, program execution methods (EDIT JCL, foreground and background modes).

Total: 45 Hours

H. Learning Resources

i) Text Books

1. Doug Lowe, "MVS JCL ", Mike Murach and Associates Inc, 2nd edition, 1994.
2. Gary DeWard Brown, JCL Programming Bible (with z/OS) fifth edition, Wiley India Dream Tech, 2002.

ii) Reference Books

1. COBOL - Language Reference, Ver 3, Release 2, IBM Redbook.
2. COBOL - Programming Guide, Ver 3, Release 2, IBM Redbook.
3. Nancy Stern & Robert A Stern, "Structured Cobol Programming", John Wiley & Sons, New York, 1973.
4. M.K. Roy and D. Ghosh Dastidar, "Cobol Programming", Tata McGraw Hill, New York, 1973.
5. Newcomer and Lawrence, Programming with Structured COBOL, McGraw Hill Books, New York, 1973.
6. Craig S Mullins, DB2 Developer's Guide, Sams Publishing, 1992.

7. Gabrielle Wiorowski& David Kull, DB2 Design & Development Guide, Addison Wesley, 1992.
8. C J Date & Colin J White, A Guide to DB2, Addison Wesley.
9. IBM Manual: DB2 Application Programming and SQL guide.

iii) WEB REFERENCES

1. <http://www-1.ibm.com/support/docview.wss?uid=pub1sa22759706>
2. http://publibz.boulder.ibm.com/cgi-bin/bookmgr_OS390/BOOKS/iea2b600/CCONENTS
3. <http://publib.boulder.ibm.com/infocenter/db2v7luw/index.jsp>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS131	BUILDING ENTERPRISE APPLICATIONS	3	0	0	3

Course Category: Program Elective

A. Preamble:

Enterprise applications are typically designed to interface or integrate with other enterprise applications used within the organization, and to be deployed across a variety of networks (Internet, Intranet and corporate networks) while meeting strict requirements for security and administration management.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS117	{HYPERLINK \l "jp"}
2	1151CS302	Java Programming Lab
3	1151CS111	Computer Networks
4	1151CS305	Computer Networks Lab

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS202	Internet Programming
2	1156CS601	Minor Project
3	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected

- To understand requirements validation, planning and estimation.
- To design and document the application architecture.
- To understand the importance of application framework and designing other application components.
- To perform Code review, Code analysis, build process.
- To understand different testing involved with enterprise application and the process of rolling out an enterprise application.

E. Course Outcomes

Students undergoing this course are able to:

CO Nos.	Course Outcomes	Level of learning domain
CO1	Familiarize with concept of Enterprise Analysis and	K2

	Business Modeling.	
CO2	Understand requirements validation, planning and estimation.	K2
CO3	Understand the importance of application framework and designing other application components.	K2
CO4	Perform Code review, Code analysis, build process.	K3
CO5	Understand different testing involved with enterprise application and the process of rolling out an enterprise application.	K2

F. Correlation of COs with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M					M						L		L	
CO2		M	M										L		L
CO3	M					L		L						M	M
CO4		M	L	L	L		L		L	L	L			M	M
CO5	M	L		M	H	L						L			

G. Course Content:

UNIT I-ANALYSIS AND MODELING

9

Introduction to enterprise applications and their types - software engineering methodologies - life cycle of raising an enterprise application - introduction to skills required to build an enterprise application - key determinants of successful enterprise applications and measuring the success of enterprise applications - inception of enterprise applications - enterprise analysis - business modeling - requirements elicitation - use case modeling - prototyping.

UNIT-IIARCHITECTURAL DESIGN

9

Nonfunctional requirements - requirements validation - planning and estimation - concept of architecture - views and viewpoints - enterprise architecture - logical architecture - technical architecture – design - different technical layers - best practices - data architecture and design – relational, XML, and other structured data representations.

UNIT-II COMMUNICATION AND INFRASTRUCTURE **9**
Infrastructure architecture and design elements - Networking, Internetworking, and Communication Protocols - IT Hardware and Software – Middleware - Policies for Infrastructure Management - Deployment Strategy - Documentation of application architecture and design.

UNIT-IV CONSTRUCTION AND REVIEW **9**
Construction readiness of enterprise applications - defining a construction plan - defining a package structure - setting up a configuration management plan - setting up a development environment - introduction to the concept of Software Construction Maps - construction of technical solutions layers - methodologies of code review, static code analysis, build and testing.

UNIT-V TESTING AND ROLL OUT **9**
Dynamic code analysis – code profiling and code coverage - types and methods of testing an enterprise application - testing levels and approaches - testing environments - integration testing - performance testing - penetration testing - usability testing - globalization testing and interface testing - user acceptance testing - rolling out an enterprise application.

Total: 45 Hours

H. Learning Resources

i) Text Books

1. Anubhav Pradhan, Satheesha B. Nanjappa, Senthil K. Nallasamy, Veerakumar Esakimuthu, "Raising Enterprise Applications", First Edition, Wiley India Pvt. Ltd, 2010
2. Brett McLaughlin, "Building Java Enterprise Applications", First Edition, O'Reilly Media publications, 2002.

ii) Reference Books

1. Soren Lauesen , "Software Requirements: Styles & Techniques", First edition, Addison-Wesley Professional publications, 2002
2. Brian Berenbach, Daniel J. Paulish, Juergen Kazmeier, Arnold Rudorfer, "Software Systems Requirements Engineering: In Practice", First Edition, McGraw-Hill/Osborne Media publications, 2009
3. Dean Leffingwell, Don Widrig , "Managing Software Requirements: A Use Case Approach", First Edition, Pearson publications, 2003

4. Varma Vasudeva, "Software Architecture: A Case Based Approach", First Edition, Pearson publications, 2009.
5. Srinivasan Desikan, Gopalaswamy Ramesh, "Software Testing Principles and Practices ", First Edition, Pearson publications, 2006
6. Software Testing Principles and Practices, Oxford University Press

iii) Web References

1. http://java.sun.com/blueprints/guidelines/designing_enterprise_applications_2e/

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS201	DEVELOPING WEB APPLICATIONS IN .NET	2	0	2	3

Course Category: Program Elective

A. Preamble:

The overall aim of this subject is to introduce you to basic concepts of OOPS concept using C# and data access programming and in order to enable you create C# projects.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS202	Internet Programming

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Learners are exposed to

- Understand the complexity of the real-world objects
- Learn the best practices for designing Web applications and Usability Reviews
- Understand the Principles behind the design and construction of Web applications.
- The objective is to expose students to project development best practices and apply the concepts assimilated during the classroom session

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Classify the .Net framework with its development platform.	K2
C02	Outline the advanced concepts in object oriented programming.	K2
C03	Design the databases using structure query language server.	K3
CO4	Explain the data accessing using ADO.NET for application development	K2
CO5	Understand the scripting languages for Web application Development.	K2

F. Correlation of COs with Pos

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M		L		L									L	
CO2	M		L		M									M	L
CO3	M		M	L	M		L						L		M
CO4	M		M	L	M									M	M
CO5	M		H		H		L	M					L		H M

H- High; M-Medium; L-Low

G.Course Content:

UNIT I INTRODUCTION TO .NET FRAMEWORK 9

Knowledge of .NET framework, .NET features and .NET development platform. Understanding advantages of .NET framework

UNIT II OBJECTED ORIENTED CONCEPTS USING CSHARP LANGUAGE 9

object oriented programming (review only) — advanced concept in OOP – relationship – inheritance – abstract classes – polymorphism – Object Oriented design methodology – approach – best practices. UML class diagrams – interface – common base class

UNIT III DESIGN AND DEVELOP DATABASE USING SQL SERVER 2008 9

To introduce features and architecture of MS – SQL Server 2008, Introduction to Database Engine and storage Engine, to enable students to create Tables, temporary tables, and Integrity rules. Ability to code in Batches, Write Stored Procedures/Functions. Ability to handle errors, Transaction in SQL server

UNIT IV DATA ACCESS PROGRAMMING USING ADO.NET 9

Understanding of challenges, with respect to data access, associated in building internet applications and concept of common data access programming model, Ability to use ADO.NET components for application development, configuring and executing various objects. Understanding connected and disconnected models for data access.

UNIT V WEB APPLICATION DEVELOPMENT USING ASP.NET 9

HTML, JavaScript, CSS, Basics of ASP.NET, Page Object and Dynamic Compilation Model, ASP.NET controls, Understand Data Binding and various Data Sources in ASP.NET. Understand the creation of Master Pages and themes. To

understand configuration of web applications, IIS configurations, State management in ASP.NET.

Total: 45 Hours

h. Learning Resources:

i. Text Books:

1. C# and the .Net Platform by Troelsen, Andrew, Apress
2. Rebecca M. Riordan, Microsoft® ADO.NET 2.0 Step by Step, Microsoft Press, 2005
3. Beginning ASP.NET 3.5, Ullman, Sussman,Kauffman,Hart, Meharry(Wrox Publications)

ii. References:

1. Inside C#, by Archer, Tom, Wrox Publication
2. Microsoft Visual C# 2005 Step by Step by Sharp, John, Microsoft, 2005
3. Murach's SQLSERVER 2008 for developers by bryanSyverson
4. Mastering Microsoft SQL SERVER 2008 by Michael Lee, Gentry Bieker
5. David Sceppa, Programming Microsoft® ADO.NET 2.0 Core Reference, Microsoft Press, 06
6. Professional ASP.NET 3.5, Anderson, Francis, Howard, Sussman, Watson (Wrox Publications)

iii. Online Resources:

- {HYPERLINK "http://utdalls.edu"}
{HYPERLINK "http://guzdial.edu"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS133	OPEN SOURCE SYSTEM	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course provides Need of Open Sources –Advantages of Open sources – Over View of Applications- FOSS – FOSS usage –Free Software Movement and concept of open Source Software to learn Linux Environment and to make students well versed with Shell Programming

B. Pre-requisite:

Sl No	Course Code	Course Name
1	1150CS201	Problem solving using C
2	1151CS102	Data Structures

C. Links to Other Courses:

Sl No	Course Code	Course Name
1	1151CS108	Operating Systems
2	1152CS118	Distributed and Parallel Computing
3	1152CS120	Cloud Computing

D. Course Educational Objectives

- Students undergoing this course are exposed to
- To introduce the concept of open Source Software.
 - To enable students to learn Linux Environment.
 - To make students well versed with Shell Programming

E. Course Outcomes:

At the end of the course, the students are able to know:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Summarize the advanced concept of Linux open source operating systems.	K2
CO2	Illustrate the concept of structure query language	K2

	with report based Hyper text preprocessor.	
CO3	Understand the operation to develop personal home page with hyper text markup language.	K2
CO4	Outline the object concepts of personal home page language.	K3
CO5	Explain the working architecture of web server with IDE application.	K2

K2-Understand, K3-Apply

F. Correlation of COs with Programme outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L											L	
CO2	H	M	L		M										L
CO3	H	M	M		L										
CO4	L		L		L								L	M	
CO5	M							L				L	M	M	

G. Syllabus Content

Unit 1 **INTRODUCTION**

9

Need of Open Sources – Advantages of Open Sources – Applications – Commercial aspects of Open Source movement – Certification courses issues. Open Source Operating Systems: LINUX – Introduction – General Overview – Kernel mode and User mode process. Advanced Concepts: Scheduling, Time Accounting – Personalities – Cloning and Backup your Linux System – Linux Signals – Development with Linux. Linux Networking: Configuration Files – Red Hat Linux network GUI configuration tools – Assigning an IP address – Subnets – Route – Tunneling – Useful Linux network commands – Enable Forwarding.

Unit 2 **MySQL**

9

Introduction – What is MySQL? - MySQL Data Types - Primary Keys and Auto Increment Fields - Queries - Download MySQL Database - Facts About MySQL database - Connecting to a MySQL Database - writing your own SQL programs - Closing a Connection. PHP MySQL Create Database and Tables: Create a Database - Create a Table - Insert Data into a Database Table - Insert Data from a Form into a Database. Record Selection Technology: Select Data from a Database Table - Display the Result in an HTML Table - The WHERE clause - The ORDER BY Keyword – Working
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with Strings – Date and Time – Working with metadata. Sorting Query Results: Sort Ascending or Descending - Order by Two Columns - Update Data in a Database - Delete Data in a Database - Using sequences – MySQL and Web. Database ODBC: Create an ODBC Connection - Connecting to an ODBC - Retrieving records - Retrieving Fields from a Record - Closing an ODBC Connection.

Unit 3	PHP INTRODUCTION	9
A Brief History of PHP - Installing PHP - A Walk Through PHP - Installing and Configuring PHP on Windows. Language Basics: Lexical Structure -Data Types - Variables -Expressions and Operators – Constants - Flow-Control Statements -Including Code -Embedding PHP in Web Pages. Functions: Calling a Function - Defining a Function - Variable Scope –Function Parameters - Return Values -Variable Functions - Anonymous Functions. Strings: Quoting String Constants - Printing Strings - Accessing Individual Characters -Cleaning Strings - Encoding and Escaping -Comparing Strings - Manipulating and Searching Strings - Regular Expressions. Arrays: Indexed Versus Associative Arrays - Identifying Elements of an Array - Storing Data in Arrays - Multidimensional Arrays - Extracting Multiple Values - Converting Between Arrays and Variables - Traversing Arrays - Sorting - Acting on Entire Arrays - Using Arrays.		
Unit 4	OBJECTS	9
Terminology - Creating an Object - Accessing Properties and Methods - Declaring a Class - Introspection – Serialization. Extending PHP: Architectural Overview - What You'll Need - Building Your First Extensions - The config.m4 File - Memory Management - The pval / zval Data Type - Parameter Handling- Returning Values - References - Global Variables - Creating Variables - ExtensionINI Entries – Resources.Databases: Using PHP to Access a Database - Relational Databases and SQL - Advanced Database Techniques - Sample Applications.		
Unit 5	WEB SERVER	9
Apache Web Server – Working with Web Server – Configuring and using apache web services. Open source software tools: Browsers – Processors – Compilers – Model driven architecture tools. Eclipse IDE platform: Architecture – History – Simultaneous Releases. Case Study: E-Governance - Government Policy toward Open Source.		

TOTAL: 45 Hours

H. Learning Resources

i. Reference Books:

1. RemY Card, Eric Dumas and Frank Mevel, "The Linux Kernel" Wiley Publications sons, 2003
2. Steve Suchring "MySQL Bible", John Wiley sons, 2002
3. Rasmus Lerdorf, Levin Tatroe and Peter MacIntyre, "Programming PHP " O'Reilly Publications, 3rd Edition, 2013.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS301	NETWORK ANALYSIS LAB	0	0	2	1

Course Category: Program Elective

A. Preamble:

Network analysis is the method of planning and controlling projects by recording their interdependence in a diagrammatic form which enables each fundamental problem involved to be tackled separately.

B. Prerequisite Courses:

S1 No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

S1 No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Minimize idle resources.
- Minimize the total project cost.
- Tradeoff between time and cost of project.
- Minimize production delays, interruptions and conflicts.
- Minimize the total project duration.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Apply the knowledge of basic circuital law and simplify the network using reduction techniques	S3
CO2	Construct the circuit using Kirchhoff's law and Network simplification theorems	S3

CO3	Infer and evaluate transient response, Steady state response, network functions	S3
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F. Correlation of COs with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L	L		L			L	M				M		L
CO2	H	L	L	M	M			L	L			L	M	L	M
CO3	M	L	L		M				M			L			

Course Content

LIST OF EXPERIMENTS:

CYCLE I

S. No	Experiment name
1	Setting up router name and password
2	Setting up telnet, MOTD banner, etc
3	Test telnet connection
4	Cisco Password Encryption
5	Switch configuration
6	Basic router configuration
7	Speed and Duplex
8	Cisco port security
9	Static Route
10	Default Route

CYCLE II

11	Rip Configuration
12	Router on a Stick
13	Spanning tree protocol
14	NAT
15	Dynamic NAT
16	Static NAT
17	Serial connection
18	PPP encapsulation
19	CDP Protocol

Online References

- <http://www.packettracerlab.com/>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS302	SAP LAB	0	0	2	1

Course Category: Program Elective

A. Preamble:

The enterprise-wide software system offers significant potential benefits, as suggested by the growing scholarly literature that seeks to conceptualize and measure types of organizational outcomes, business impacts, and return on investment among ERP adopting enterprises.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
		NIL

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Learners are exposed to

- understand business-centric information system
- to implement ERP/SAP software.

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Demonstrate and design the enterprise resource planning modules.	S2
C02	Develop applications using advanced business application programming and business server page.	S3
C03	Construct and implement the different modules of SAP	S3
CO4	Summarize and implement the various types of customizing SAP ERP application modules	S3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		L		L			L				L		L	L
CO2	M	L	L		M			L				M		M	L
CO3	M	L	M		M			M				M		M	L
CO4	M	L	M		M			M				M		L	L

H- High; M-Medium; L-Low

G. Course Content

LIST OF EXPERIMENTS:

S. No	Experiment name
1	SAP interface navigation
2	Application modules & business process procedures implementation
3	Application modules Process modeling diagrams
4	Accelerated SAP
5	Fitter Snacker Configuration: Implementation Guide (IMG)
6	Fitter Snacker Configuration: financial accounting
7	Business area customization
8	Testing Fitter Snacker configuration
9	ERPSim Simulation game

H. Learning Resources:

i. Online References

- {HYPERLINK "http://www.eoktechnologies.com/sabs_eok.pdf"}
- http://www.trainning.com.br/download/sap4_basic.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS303	PROGRAMMING WITH PHP	0	0	4	2

Course Category: Program Elective

A. Preamble :

This course provides basic concepts about PHP, Database connectivity and advanced PHP programming skills. Use PHP and MySQL to develop dynamic web sites for user on the Internet. This course will help to develop web sites ranging from simple online information forms to complex e-commerce sites. After successful completion of this course learners can able to develop web applications.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS117	Programming in Java
2	1151CS202	{HYPERLINK \l "ip"}

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives :

Learners are exposed to

- Understand the general concepts of PHP scripting language for the development of Internet websites.
- Understand the basic functions of MySQL database program.
- Develop simple applications programs and web applications.
- Design and implement a Mini projects using the learned techniques.

E. Course Outcomes :

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Demonstrate the basics of PHP programming Fundamentals.	S3
CO2	Solve programs using control structures, arrays,	S3

	functions and debug script.	
CO3	Develop forms and Database connectivity using MySQL.	S3
CO4	Implement the ability to post and publish a PHP website	S3
CO5	Develop web applications in PHP	S3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO3.	L				L			L	L				L	L	L
CO4.	L		L		M			L	L				L	L	L
CO3	L	M	M		H			H	H	M	H	M	L	H	M
CO4					L			L	L				L	L	L
CO5	L	M	H	M	H			H	H	M	H	M	L	H	H

H- High; M-Medium; L-Low

G.Course Contents

List of Experiments

1. Develop PHP programs based on fundamentals and Control loops
2. Develop PHP programs based on strings, Arrays
3. Develop PHP programs based on functions, Class and objects.
4. (a)Write a simple PHP program to check that emails are valid.
(b)Form parsing in PHP.
(c)PHP Store Form Data Into Database (HTML)
5. Develop a PHP program sending an E-mail
6. (a)Handling Files and Directories
(b)Develop PHP Custom Search engine
7. Building MYSQL Queries, complex Queries
8. Develop User Authentication scripts
9. Create an Online product Catalogue Application
10. Develop shopping cart application
11. Develop website for an Organization
12. Develop Website for Tourism

Total: 60 Hours

H. Learning Resources:

i. Text Books:

1. PHP CookBook, David Sklar & Adam Trachtenberg, O'reilly.
2. PHP A Beginners Guide , VikramVaswani, Tata Mcgraw Hill.
3. Beginning PHP6, Apache, MySQL Web Development ,WROX

ii. References:

1. PHP: The Complete Reference , Stephen Holzner
2. Mastering PHP, 1 Ed by Webtech Sol., Khanna Publishing, 2012
3. PHP and MYSQL Web development All-in-One Desk Reference For Dummies, John Wiley & Sons
4. PHP Professional Projects, Prentice Hall of India, 2002.

iii. Online Resources:

1. {HYPERLINK "https://www.coursera.org/learn/web-applications-php"}
2. {HYPERLINK "https://www.udemy.com/learn-advanced-php-programming/"}
3. {HYPERLINK "http://W3resource.com/"}
4. {HYPERLINK "http://www.ptutorial.com/"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS304	ORACLE 11g LAB	0	0	4	2

Course Category: Program Elective

A. Preamble:

This course starts from developing a simple query to notification and security level issues that involve various events. Also students are encouraged to do a Minor Project with the help of Java/Visual basic with ORACLE on their own that tunes out them in finding various procedures that suits the need of the application.

B. Pre-Requisite:

Sl. No	Course Code	Course Name
1	1151CS303	Database Management System Lab

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

At the end of the course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Experiment the working of Oracle 11 g database.	S3
CO2	Construct an External table and access the Remote data along with an XML Documents.	S3
CO3	Modify the privileges for the user data.	S3
CO4	Generate the SQL Report, organizing Backup and Recovery files.	S3

K3-Apply, K4-Analyse, S3-Processes

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	M	H	L	L							M	M
CO2	H	H	H	M	H	L	L							M	M
CO3	M	M	H	M	H	L	L							M	M
CO4	H	M	H	M	H									M	M

F. Course Content**LIST OF EXPERIMENTS****Cycle-1**

- 1) Installing ORACLE 11g to windows / Linux.
- 2) Experiments on creating and managing tables, views, indexes, clusters and sequences.
- 3) Implementation of Case and Decode: If, then & else in SQL.
- 4) Experiments using LOB.
- 5) Creating and accessing an external table.
- 6) Working with Table space and Accessing with remote Data.

Model practical Examination-I**Cycle-2**

- 7) Accessing XML documents using methods in oracle.
- 8) Creating user and providing security for table partition.
- 9) Automatic Files Backup and Files Recovery.
- 10) Generating report in SQL * plus.
- 11) Mini project

Model practical Examination-II**G. Learning Resources:****i. Text Books:**

1. Kevin Loney, "Oracle Database 11g The Complete Reference", MaGraw Hill Edition 2009.

2. Alice Rischert, "Oracle SQL by Example (Prentice Hall Professional Oracle Series)" 4th edition

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS205	COMPETITIVE PROGRAMMING	2	0	4	4

Course Category: Program Elective

A. Preamble :

This course provides comprehensive introduction to modern competitive programming, Number theory and to design the programming techniques for performing searching, sorting. This course also used to learn the methodology of dynamic programming, Graph algorithms and to develop algorithms for Parallel, Tree problems, string algorithms and Optimization techniques.

B. Prerequisite Courses:

SI No	Course Code	Course Name
1	1150CS201	Problem Solving using C
2	1151CS102	Data Structures
3	1151CS106	Design and Analysis of Algorithm
4	1151CS119	Introduction to Design and Analysis of Algorithms

C. Related Courses:

S. No	Course Code	Course Name
1	1151CS103	Programming in Java
2	1151CS117	Java Programming
3	1151CS202	Internet Programming

D. Course Educational Objectives :

Learners are exposed to

- To understand the general concepts of programming and Number theory
- To understand the programming techniques and method of performing searching, sorting.
- To learn the methodology of dynamic programming, Graph algorithms.
- Develop algorithms for Parallel and Tree problems
- To learn string algorithms and Optimization techniques.

E. Course Outcomes :

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Demonstrate the basics of programming and mathematical fundamentals.	K2, S3
CO2	Explain the efficient programs for sorting, searching arrays and structures with time complexity.	K2, S3
CO3	Utilize the Methodology of Dynamic Programming for solving the Graph Algorithms.	K3, S3
CO4	Develop algorithms for Bit Parallel, Trees and Geometry problems.	K3, S3
CO5	Solve the arrays, String algorithms, Square Root Techniques for Dynamic Programming Optimization.	K3, S3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO3.	H	M	L	L	L		L	L			L	L	M		
CO4.	M	L	L	L	M		L	L			M	L	L	M	
CO3	M	L	M	L	M		M	L			L	L		M	
CO4	H	L	L	L	L		L	L			L	L	M	M	
CO5	H	L	L	L	M		L	L			L	L	M	M	

H- High; M-Medium; L-Low

G. Course Contents:

Unit I	6 Hrs
Competitive Programming – Programming Contests and Tips for Practicing, CSES Problem Set and Other Resources	
Review of Mathematics- Number Theory, Combinatorics, Matrices, Probability and Game Theory	
Unit II	6
Programming Techniques- Language Features, Recursive Algorithms and Bit Manipulation Efficiency – Time Complexity and Examples	
Sorting and Searching – Sorting Algorithms, Solving Problems by Sorting, Binary Search	
Data Structures – Dynamic Arrays, Set Structures and Experiments	
Unit III	6
Dynamic Programming – Basic Concepts and Examples	
Graph Algorithms –Basics of Graphs, Graph Traversal, Shortest Paths, Directed Acyclic Graphs, Successor Graphs, Minimum Spanning Trees, Strong Connectivity, Complete Paths, Maximum Flows and Depth First Trees	
Unit IV	6
Algorithm Design Topics – Bit-Parallel Algorithms, Amortized Analysis and Finding Minimum Values	
Range Queries- Queries on Static Arrays and Tree Structures	
Tree Algorithms – Basic Techniques, Tree Queries and Advanced Techniques, Geometry – Geometric Techniques and Sweep Line Algorithms	
Unit V	6
String Algorithms – Basic Concepts, String Hashing, Z-algorithm, and suffix Arrays	
Additional Topics – Square Root Techniques, Segment Tress Revisited, Treaps, Dynamic Programming Optimization and Miscellaneous.	

Total : 30 Hours

Practical:60 Hours

H. Text Book

1. Antti Laaksonen, Guide to Competitive Programming : Learning and Improving Algorithms Through Contests, Springer,ISBN: 978-3-319-72546-8, 2017
- 2.

I. Reference Books:

1. Antti Laaksonen, Competitive Programmer's Handbook, Draft December, 2017, <https://cses.fi/book/book.pdf>.
2. Steven Halim and Felix Halim, Competitive Programming, Third Edition, National University of Singapore, 2013, https://www.comp.nus.edu.sg/~stevenha/myteaching/competitive_programming/cp1.pdf
3. Thomas H. Cormen et al., Introduction to Algorithms, MIT, Third Edition, ISBN-13: 978-0262533058 & ISBN-10: 0262533057, 2009
4. Sartaj Sahni, Data Structures, Algorithms, and Applications in C++, Silicon Press, Second Edition, 2004
5. Sartaj Sahni, Data Structures, Algorithms, and Applications in Java Silicon Press, Second Edition, 2004

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS148	MODERN NUMBER THEORY	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course introduces to the concepts of number theory, computation theory computational number theory; and emphasizes their significance in modern cryptography.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150MA202	Engineering Mathematics-I
2	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS155	Principles of Cyber Physical Systems
2	1152CS156	Modern Cryptography Theory
3	1152CS157	Ethical Hacking
4	1152CS158	Cyber Security
5	1156CS601	Minor Project
6	1156CS701	Major Project

D. Course Outcomes :

Upon successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss how number theory is related to and used in	K2

	modern cryptography.	
CO2	Manipulate the properties implied by the definitions of groups, fields and rings	K3
CO3	Apply the multiplicative inverse function to solve linear congruences	K3
CO4	Apply the concepts of primality testing to prove the Prime Number Theorem with an error term.	K3
CO5	Analyse and solve problems involving integer factorization	K3
CO6	Apply the properties of discrete logarithms to solve exponential and Index Calculus problems.	K3

E. Correlation of COs with POs :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	L				L				L	L	M	M
CO2	H	M	L	L	L				L	L	L	M	M		
CO3	M	M	L	L	L								M	L	M
CO4	H	H	M	L	L							M			
CO5	M	M	M	L	L							L	M		
CO6	H	M	L	L	L			L	L	L	L	M	L	L	L

H- High; M-Medium; L-Low

F. Course Content :

UNIT I INTRODUCTION TO CRYPTOGRAPHY

L – 9

Introduction - Number Theory, Computation Theory, Computational Number Theory and Modern Cryptography.

Secret-Key Cryptography - Cryptography and Cryptanalysis, Classic Secret-Key and Modern Secret-Key Cryptography.

UNIT II FUNDAMENTALS OF NUMBER THEORY

L – 9

Fundamental(L/M) - Basic Algebraic Structures, Divisibility Theory and Arithmetic Functions.

UNIT III CONGRUENCE THEORM**L – 9**

Fundamental(M/M) - Congruence Theory , Primitive Roots and Elliptic Curves

UNIT IV PRIMALITY TESTING AND INTEGER FACTORIZATION**L – 9**

Primality Testing – Basic Tests, Miller-Rabin Test, Elliptic Curve Test and AKS Test
Integer Factorization(L/M) - Basic Concepts, Trial Division Factoring, ρ and $\rho - 1$ Methods and Elliptic Curve Method

UNIT V DISCRETE LOGARITHMS**L – 9**

Integer Factorization(M/M) - Continued Fraction Method, Quadratic Sieve and Number Field Sieve

Discrete Logarithms – Basic Concepts, Baby-Step Giant-Step Method, Pohlig-Hellman Method, Index Calculus and Elliptic Curve Discrete Logarithms

Total: 45 Periods**G. Learning Resources****i. Text Books:**

1. Song Y. Yan, "Computational Number Theory and Modern Cryptography", John Wiley (ISBN 978-L-LL8-L8858-H), M0LH.

ii. Reference:

1. David M. Burton, "Elementary Number Theory", Seventh Indian Edition (Indian , McGraw Hill Education), M0LM.
2. K.Rosan, "Elementary Number Theory and its Application", Fifth Edition, Addison-Wesley,M005.
3. Marlow Anderson, Todd Feil, "A First Course in Abstract Algebra Rings, Groups, and Fields", Third edition, CRC Press, M0L5.

iii. Online resources

1. <http://people.reed.edu/~jerry/H6L/lectures/mats.html>
2. <http://citeseerx.ist.psu.edu/viewdoc/download?doi=L0.L.L.705.8H87&rep=repL&type=pdf>
3. <http://nptel.ac.in/courses/LLLL0H0M0/>
4. <https://ocw.mit.edu/courses/mathematics/L8-785-number-theory-i-fall-M0L6/syllabus/>
5. <http://archives.math.utk.edu/topics/numberTheory.html>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS156	MODERN CRYPTOGRAPHY THEORY	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course introduces to the concepts of IFP-based cryptographic systems and protocols, Discrete Logarithm Based Cryptography, Quantum Resistant Cryptography; Block Chain Technology and emphasizes their significance in modern cryptography.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1152CS148	Modern Number Theory

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS158	Cyber Security
2	1156CS601	Minor Project
3	1156CS701	Major Project

D. Course Outcomes:

Upon successful completion of the course, the students shall attain the abilities to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Apply the concepts of integer factorization to solve simple cryptographic problems	K3

CO2	Apply the concepts of discrete logarithms to solve simple cryptographic problems	K3
CO3	Apply the concepts of elliptic curve discrete logarithms to solve simple cryptographic problems	K3
CO4	Summarize the concepts of Quantum computational number theory to solve simple cryptographic problems	K2
CO5	Outline basic concepts of Block Chain Technology in Crypto currencies.	K2

E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		H										M		
CO2	H		H		L	L					L		M		
CO3	M		H		L	L					L		M		
CO4	H		H	L		L		M	L				M		L
CO5	M	H	L	L							L	M			L

H- High; M-Medium; L-Low

F. Course Content:

UNIT I: INTEGER FACTORIZATION BASED CRYPTOGRAPHY 9

RSA Cryptography- Cryptanalysis of RSA- Rabin Cryptography- Residuosity Based Cryptography- Zero-Knowledge Proof.

UNIT II: DISCRETE LOGARITHM BASED CRYPTOGRAPHY 9

Diffie Hellman Merkle Key Exchange Protocol- ElGamal Cryptography- Massey Omura Cryptography- DLP Based Digital Signatures

UNIT III: ELLIPTIC CURVE DISCRETE LOGARITHM BASED CRYPTOGRAPHY 9

Basic Ideas- Elliptic Curve Diffie Hellman Merkle Key Exchange Scheme- Elliptic Curve Massey Omura Cryptography- Elliptic Curve ElGamal Cryptography- Elliptic Curve RSA Cryptosystem.

UNIT IV: QUANTUM COMPUTATIONAL NUMBER THEORY **9**

Quantum Algorithms for Order Finding- Quantum Algorithms for Integer Factorization-Quantum Algorithms for Discrete Logarithms- Quantum Algorithms for Elliptic Curve Discrete Logarithms- Coding Based Cryptography- Lattice-Based Cryptography- Quantum Cryptography

UNIT V:INTRODUCTION TO BLOCK CHAIN TECHNOLOGY**9**

Block Chain Technology- Working of Block Chain Technology- Financial and Non-Financial applications, and implementation

Total: 45 Periods**G. Learning Resources****i. Text Books:**

1. Song Y. Yan, "Computational Number Theory and Modern Cryptography", John Wiley (ISBN 978-1-118-18858-3), 2013.
2. Narayanan A, Bonneau J, Felten E, Miller A, and Goldfeder S, Bit coin and Cryptocurrency Technologies- A Comprehensive Introduction, Princeton University Press, 2016.

ii. Reference:

1. William Stallings, "Cryptography and Network Security: Principles and Practice", Seventh edition, Pearson, 2016
2. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography" CRC PRESS, 2007.
3. Gilles Van Assche, "Quantum Cryptography and Secret-Key Distillation", Cambridge University Press, 2006.
4. {HYPERLINK "<https://www.chatreddaccountantsanz.com/>"} The Future of Block Chain: Applications and Implementations of Distributed Ledger Technology.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS206	STATISTICAL METHODS FOR DATA SCIENCE	3	0	2	4

Course Category: Program Elective

A. Preamble:

This course introduces to the concepts of Statistical Methods for Data Analysis.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150MA201	Applied Statistics

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS139	Data Science

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level
CO1	Explain the Basic Statistical Concepts	K2,S2
CO2	Apply the concept Comparing Means in given data	K3,S2
CO3	Experiment the Chi-Square Test and Correlation Analysis	K3,S2
CO4	Explain about Multiple Regression and Logistic	K2,S2
CO5	Demonstrate the concepts Data Reduction and Scale Reliability	K2,S2

E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	L								L	M		
CO2	H	M	L	L				L					H	L	
CO3	M	M	L	M	M			M				L	M	M	
CO4	H	H	M	L								M	M		
CO5	M	M	M	L	M			M				L	M	L	L

H- High; M-Medium; L-Low

F. Course Content

UNIT I Basic Statistical Concepts and Descriptive Statistics	9
SPSS-Research in Behavioral Sciences- Types of Variables- Hypothesis Testing - Descriptive Statistics: Basic Concepts	
UNIT II Comparing Means	9
Comparing Means: t-test and z-test, One Sample t-test, Independent Samples t-test; Dependent Samples t-test; Analysis of Variance- ANOVA Procedure- Factors and Covariates- Main Effects and Interactions- Post-Hoc Multiple Comparisons; Two-Way Between-Groups ANOVA	
UNIT III Chi-Square Test and Correlation Analysis	9
Chi-Square Test of Independence- Contingency Tables-Correlation, Nature of Variables- Bivariate/Partial Correlation	
UNIT IV Multiple Regression and Logistic	9
Regression Coefficient, R Values, Multiple Regression Types; Logistic Regression Coefficients Fit Indices- Logistic Regression Types	
UNIT V Data Reduction and Scale Reliability	9
Factor and Component- Extraction- Factor Loadings- Rotation- Communalities- Eigenvalue and Scree Plot- Scale Reliability	
List of Lab Experiments	P-30
1. Calculate some basic descriptive statistics for this data	
2. t-test	
3. One-Way ANOVA	
4. Chi-square test	
5. Correlation Bivariate	
6. Correlation Partial	
7. Regression Multiple	
8. Regression Logistic	
9. Data reduction	
10. Reliability Analysis	

Total: 75 Hours

G. Learning Resources

i.Text Book

{PAGE }

1. "Statistical Methods for Practice and Research: A guide to data analysis using SPSS" by Ajai S. Gaur, Sanjaya S. Gaur

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS139	DATA SCIENCE	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course introduces to the concepts of Data Science.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS107	Data Base Management System

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the basics of big data analytics life cycle	K2
CO2	Outline the data analysis concepts using R	K2
CO3	Interpret the association rules and regression technique	K2
CO4	Explain the concepts of classification and time series analysis	K2
CO5	Relate the text analysis and Hadoop map reduce technology	K2

E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	L	M		M						L	M		L
CO2	M	M	L	M									M		L

CO3	M	L	L	L								L	M		M
CO4	M	L	M	L								M	M	L	M
CO5	L	M	M	M	M							L	L	M	M

H- High; M-Medium; L-Low

F. Course Content

UNIT I Big Data Analytics	9
Big Data Overview - State of the Practice in Analytics - Data Analytics Lifecycle - Phase 1: Discovery - Phase 2: Data Preparation - Phase 3: Model Planning - Phase 4: Model Building - Phase 5: Communicate Results - Phase 6: Operationalize	
UNIT II Data Analytic Methods Using R	9
Introduction to R - Exploratory Data Analysis - Statistical Methods for Evaluation - Advanced Analytical Theory and Methods: Clustering	
UNIT III Association Rules & Regression	9
Association Rules - A priori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Validation and Testing. Regression - Linear Regression – Use Cases - Model Description - Logistic Regression - Use Cases - Model Description	
UNIT IV Classification & Time Series Analysis	9
Decision Trees - Naive Bayes - Diagnostics of Classifiers- Additional Classification Methods. Overview of Time Series Analysis - ARIMA Model- Additional Methods	
UNIT V Text Analysis & Technology	9
Text Analysis Steps - Collecting Raw Text - Representing Text – TFIDF. Analytics for Unstructured Data: MapReduce, Apache Hadoop	

Total: 45 Hours

G. Learning Resources

Text Book

1. Data Science & Big Data Analytics Discovering, Analyzing, Visualizing and Presenting Data EMC Education Services.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS140	MACHINE LEARNING TECHNIQUES	3	0	0	3

Course Category: Program Elective

A. Preamble :

To provide an in-depth knowledge about machine learning concepts and identify applications suitable for different types of machine learning with suitable justification

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1.	1151CS107	Database Management System

C. Related Courses:

S. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Outline the basic concepts of machine learning	K2
CO2	Summarize supervised learning and classification techniques	K2
CO3	Apply the concept of unsupervised learning and Clustering for applications	K3
CO4	Illustrate the concept of Dimensionality Reduction.	K2
CO5	Infer theoretical and practical aspects of reinforcement learning	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H					L						L		L	
CO2	H	H	H	L		L		L	L		L	L	H	M	L
CO3	H	H	M	L		L		L	L		L	L	H	M	L
CO4	H	L	M	L		L						L			
CO5	H	L	H			L		L				L		L	

H- High; M-Medium; L-Low

F. Course Content

UNIT I INTRODUCTION 5

Machine Learning - Examples of machine learning applications- Types of machine learning –Model selection and generalization – Guidelines for Machine Learning Experiments

UNIT II SUPERVISED LEARNING 10

Classification - Decision Trees – Univariate Tree –Multivariate Tree - Pruning – Perceptron – Multilayer Perceptron - Back Propagation – Cross Validation and Resampling Methods

UNIT III UNSUPERVISED LEARNING 10

Clustering- Mixture densities -K-means - EM Algorithm – Supervised Learning After Clustering- Hierarchical Clustering

UNIT IV DIMENSIONALITY REDUCTION 10

The Curse of Dimensionality –Subset Collection - Principal Component Analysis - Factor Analysis – Linear Discriminant Analysis

UNIT V REINFORCEMENT LEARNING 10

Single State Case – Elements of Reinforcement Learning - Model Based Learning – TemporalDifference Learning –Generalization in Reinforcement Learning - Policy Search

TOTAL: 45 Hours

i. Learning Resources

1. EthemAlpaydin, Introduction to Machine Learning MIT Press, 2014.

ii. REFERENCE BOOK

1. Tom M Mitchell, Machine Learning, First Edition, McGraw Hill Education, 2013
2. Richard S. Sutton and Andrew G. Barto: Reinforcement Learning: An Introduction.
MIT Press

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS209	Internet of Things	3	0	2	4

Course Category: Program Elective

A. Preamble :

The core modules of this elective course include introduction to IoT, Elements of IoT, Data Analytics and IoT Platform. This course aims to teach the student to understand the concepts of Internet of Things(IoT) and can able to practice the same with practical kits to build IoT applications.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS118	Microprocessors and Controllers

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the basic concepts and Architectures of Internet of Things.	K2
CO2	Extend their knowledge in Data Management, Smart Objects and Communication Criteria of IoT	K2
CO3	Explain the IEEE standards and basic protocols of IoT	K2
CO4	Summarize the data analytics and securing concepts in IoT	K2
CO5	Develop the project for the given scenario.	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	M	L		M					M			
CO2	M	L		M					M			
CO3	M											
CO4	M	L		L								
CO5	H	M	M	M	M	L	L	L	M	L	M	M

F. Course Content :

Unit I Introduction and Architecture of IoT 9

Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT – Comparing IoT Architectures: The oneM2M IoT Standardized Architecture, The IoT World Forum (IoTWF) Standardized Architecture : Physical Devices and Controllers Layer, Connectivity Layer - Edge Computing Layer, Upper Layers - A Simplified IoT Architecture – Core IoT Functional Stack.

Unit II Data Management, Smart Objects and Communication Criteria 9

IoT Data Management and Compute Stack - Fog Computing - Edge Computing - The Hierarchy of Edge, Fog, and Cloud - Sensors , Actuators, Micro-Electro-Mechanical Systems (MEMS), Smart Objects - Wireless Sensor Networks (WSNs) - Communication Protocols for Wireless Sensor Networks - Communications Criteria : Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained - Node Networks, Data Rate and Throughput, Latency and Determinism, Overhead and Payload.

Unit III Access Technologies and Application Protocols for IoT 9

IEEE 802.15.4 – IEEE 1901.2a - IEEE 802.11ah – IEEE 802.11ab – LoRaWAN - The Transport Layer - IoT Application Transport Methods : Application Layer Protocol Not Present, SCADA, Background on SCADA, Adapting SCADA for IP, Tunneling Legacy SCADA over IP Networks, SCADA Protocol Translation, SCADA Transport over LLNs with MAP-T, Generic Web-Based Protocols, IoT Application Layer Protocols, CoAP, Message Queuing Telemetry Transport (MQTT).

Unit IV Analytics Concepts and Securing IoT 9

Data Analytics - Edge streaming Analytics – Network Analytics - Securing IoT: Common Challenges in OT Security, Erosion of Network Architecture, Pervasive Legacy Systems, Insecure Operational Protocols, Modbus, Distributed Network Protocol, Inter-Control Center Communications Protocol, OLE for Process Control, International Electro-technical Commission Protocols.

Unit V Smart City and Public Safety

9

Smart City IoT Architecture- Smart City Security Architecture - Smart City Use-Case Examples - Overview - An IoT Blueprint for Public Safety - Emergency Response IoT Architecture - IoT Public Safety Information Processing - School Bus Safety – Case Study.

Total: 45 Hours

Lab Experiments: (30 Hours)

1. Study about Arduino interfaces and Raspberry PI interfaces
2. Study the basic fundamental components of IoT
3. Create interface between Arduino board and system
4. Verify the blinking LED and turn on/off the LEDs in a sequential manner using Arduino Uno.
5. To control the LED using a Potentiometer.
6. To control the RGB LED using a Arduino Uno.
7. Interface GSM module with Arduino Uno to communicate with the Mobile devices.
8. To interface the ultrasonic sensor with the Arduino Uno to determine the distance of an object from the sensor.
9. To interface the DS18B20 temperature sensor with the Arduino UNO to sense the temperature and print it on the serial monitor.
10. To interface the FC-51 Infrared sensor (IR) sensor with the Arduino Uno to sense the path is clear/ indicate the presence of any obstacles.
11. To build traffic lights controller using Arduino Mega.
12. To control servo motor Using Rasberry Pi.
13. To interface HC-05/HC-06 Bluetooth module with the Arduino Uno to communicate with mobile phone over short distances.
14. Case Study:
Develop any smart automation application using IoT components (Arduino Nano, HC-06 Bluetooth, Xbee Pro, Sensors)

G. Learning Resources

i. Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Honbo Zhou, The Internet of Things in the Cloud: A Middleware Perspective,CRC Press, 2012

ii. References

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.
3. Michael Margolis, "Arduino Cookbook" OReilly, Second Edition, 2011.

iii. Online Resources

1. <https://www.arduino.cc>
2. <http://www.theinternetofthings.eu/what-is-the-internet-of-things>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS207	Machine Learning using R	1	0	4	3

Course Category: Program Elective

A. Preamble:

The core modules of this elective include introduction to Machine learning and R Programming, Exploratory Data Analysis, Machine Learning Techniques.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS201	Problem Solving using C.
2	1150MA201	Applied Statistics.

C. Related Courses:

Sl No	Course Code	Course Name
1	1152CS140	Machine Learning Techniques

D. Course Educational Objectives:

Learners are exposed to

- Understand and Appreciate why data science is gaining importance in today's business world.
- Comprehend where data science can be applied in different scenarios across industry domains.
- Understand the fundamentals of R language .
- Identify various data importing, manipulation techniques in R and perform exploratory data analysis
- Recognize various machine learning techniques such as supervised and unsupervised learning etc. across several use cases.

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)

CO1	Understand the basics of Machine Learning and R Constructs.										K2		
CO2	Apply Machine Learning techniques such as regression and classification.										K3		
CO3	Implement the Clustering techniques and improve the model performance.										K3		

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1.	M		L		H										
CO2.	H	L			M	M					M		M		
CO3	H	M			M	M			M		M	M	M		

G. Course contents

UNIT I Introduction to Machine Learning and R L-3

The origins of machine learning - Machine learning with R: Loading and unloading R packages, R data structures, Managing data with R-Applications of R Programming in Real world.

UNIT II Predictive Model L-6

Supervised Learning Algorithm: Classification using Nearest Neighbors, Naive Bayes and Decision Trees - Regression Methods -Support Vector Machines.

Unit III Descriptive Model L-6

Unsupervised Learning Algorithm: Market Basket Analysis Using Association Rules, Clustering with k-means - Evaluating Model Performance - Improving Model Performance.

Lab Experiments: P-60

1. Implement Factors and Vector Manipulation.
2. Implement Matrix Arithmetic Operations.
3. Implement the concepts of Lists and Data Frames.
4. Implement Functions and String Construction.
5. Reading and Writing Files.
6. Implement Classification using Nearest Neighbors.
7. Implement Classification using Naive Bayes.

8. Implement Classification using Decision Trees.
9. Implement Linear Regression.
10. Implement Support Vector Machines.
11. Implement Market Basket Analysis using Association Rules.
12. Implement K-means Clustering Algorithm.
13. Implement Hierarchical Clustering Algorithm.
14. Write a program to measure performance for classification.
15. Write a program for improving model performance using random forest.

Total: 75

H. Learning Resources:

i)Textbooks

1. Brett Lantz,"Machine Learning with R", Second Edition, Packt Publishing Ltd, 2015.
2. Scott V. Burger," Introduction to Machine Learning with R" O'reilly Publication,2018.
3. Wickham, Hadley," Advanced R" CRC Press, 2014.

ii. Reference Books

1. Jiawei Han, Micheline Kamber, Jian Pei," Data Mining Concepts and Techniques" Third Edition, Elsevier Inc, 2012.
2. Nina Zumel and John Mount," Practical Data Science with R" Manning Publications Co, 2014.
3. Jared P. Lander "R for Everyone -Advanced Analytics and Graphics", Pearson Education, 2014.

iii. Online Resources

(<https://archive.ics.uci.edu/ml/datasets.html>).

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS306	Map Reduce and Hadoop Tools	0	0	4	2

Course Category: Program Core

A. Preamble:

This course focuses on installation of Hadoop Framework, to develop applications based on Map Reduce model and the students will be able to understand the Hadoop Analyzing and Storage Tool (Pig and Hive).

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1151CS302	Java Programming Lab
2	1151CS303	Database Management system Lab

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS121	Big Data and Analytics
2	1152CS210	Big data analytics and Tools

D. Course Outcomes:

Students undergoing this course are able to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
1	Learn and install Hadoop to use its API.	K3,S3
2	Understand the concepts of MapReduce and implement applications.	K3,S3
3	Be familiar with the Pig and Hive tools.	K3,S3

E. Correlation with Programme Outcomes:

H- Strong; M-Medium; L-Low

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1.	M	M	H	M	H				L			L			L
CO2.	M	M	H	M	H				L		M	L		H	M
CO3	M	L	H	M	H				L			L		M	L

F. Course Content

LIST OF EXPERIMENTS:

S. No Experiment Name

1. Perform setting up and Installing Hadoop in standalone mode and use web based tools to monitor the setup.
2. Perform setting up and Installing Hadoop in distributed mode and monitor the setup.
3. Implement the following file management tasks in Hadoop:
 - Adding files and directories
 - Retrieving files
 - Deleting files
4. Program to use APIs of Hadoop to interact with it.
5. Mount the one node Hadoop cluster using FUSE.
6. Implement Word Count/Frequency Programs program to understand Map Reduce Paradigm.
7. Implement Hadoop Kmer counting.
8. Write Map Reduce program that mines weather data.
9. Implement Matrix Multiplication with Hadoop Map Reduce.
- 10&11. Install, Run Pig and write Pig Latin scripts to sort, group, join, project, and filter data.
- 12&13. Install, Run Hive and use Hive to create, alter, and drop databases, tables, views, functions, and indexes.

Model Examination

G. Learning Resources

i. References

- Tom White "Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
- Dirk deRoos, Paul C. Zikopoulos, "Hadoop For Dummies", A Wiley Brand, 2014
- Edward Capriolo, Dean Wampler, and Jason Rutherglen , "Programming Hive", O'reilly Media, 2012.
- Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
- Alan Gates and Daniel Dai, "Programming Pig -Dataflow scripting with Hadoop", O'Reilley, 2ndEdition, 2016.

iii. Online Resources

- <http://hadoop.apache.org/common/docs/r0.20.2/api/>
- <http://hbase.apache.org/docs/current/api/index.html>
- <https://hadoop.apache.org/>
- <http://pig.apache.org/docs/r0.7.0/tutorial.html>
- <https://cwiki.apache.org/confluence/display/Hive/Home>
- <http://schatz-lab.org/teaching/exercises/hadoop/>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS137	ARTIFICIAL INTELLIGENCE	3	0	0	3

Course Category: Program Elective

A. Preamble :

Artificial Intelligence is one of the most advanced fields of computer science which involves use of Mathematics, Statistics, Information Technology and Information Sciences in discovering new information and knowledge from large databases and optimize Human effort overall. It is a new emerging interdisciplinary area of research and development which has created interest among scientists of various disciplines like Computer Science, Mathematics, Statistics, Information Technology.

B. Prerequisite courses:

S.No	Subject Code	Subject Name
01	1151CS102	Data Structures

C. Related Courses:

S.No.	Subject Code	Subject Name
01	1152CS124	Soft Computing
02	1152CS140	Machine Learning Techniques
03	1152CS110	Knowledge Based Decision Support Systems
04	1152CS207	Machine Learning using R

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO No.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Exponent the problem solving by Searching State Space.	K2
CO2	Solve Problem by Heuristic approach.	K3
CO3	Solve Problem by Random and Optimal approaches.	K3
CO4	Solving Constraint-satisfaction problem and Planning .	K3

CO5	Utilize Logical knowledge representation.										K3		
CO6	Experiment with Uncertainty and Reasoning										K3		

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H				L								M		
CO2	H	H	H										M		
CO3	H	H	M	L	L								M	L	
CO4	H	L	M	M	M	L							L	M	M
CO5	H	L	H		H						M				M
CO6	H	L	M	M	M	L							L	M	M

H- High; M-Medium; L-Low

F. Course Content :

UNIT – I Basic Search Techniques: 9

Artificial Intelligence - Introduction. **State Space Search**: Generate and Test- Simple Search- Depth First Search- Breadth First Search- Comparison of BFS and DFS- Quality of Solution- Depth Bounded DFS- Depth First Iterative Deepening.

Heuristic Search: Heuristic Functions- Best First Search- Hill Climbing- Local Maxima- Solution Space Search- Variable Neighborhood Descent- Beam Search- Tabu Search- Peak to Peak Methods.

UNIT – II Advanced search techniques: 9

Randomized Search and Emergent Systems: Iterated Hill Climbing- Simulated Annealing- Genetic Algorithms- The Travelling Salesman Problem- Neural Networks- Emergent Systems- Ant Colony Optimization. **Finding Optimal Paths**: Brute Force- Branch & Bound- Refinement Search- Dijkstra's Algorithm- Algorithm A*- Iterative Deepening A*- Recursive Best First Search.

UNIT – III Planning and Strategies 9

Planning: The STRIPS Domain- Forward and Backwards State Space Planning- Goal Stack Planning- Plan Space Planning- A Unified Planning Framework. **Constraint Satisfaction Problem**: N-Queens- Constraint Propagation- Scene Labeling- Higher Order and Directional Consistency- Algorithm Backtracking- Look-ahead Strategies- Strategic Retreat.

UNIT – IV Knowledge Representation	9
Structured Knowledge Representation: Hierarchies in Domain- The Scheme- Frames- Semantic Net- Scripts, Goals, Plans and MOPs- Inheritance in Taxonomies- Description Logics- Formal Concept Analysis- Conceptual Graphs.	

UNIT – V Knowledge Facets and Logic Inferences	9
Knowledge Based Reasoning: Agents- Facets of Knowledge. Logic and Inferences: Formal Logic- Propositional Logic- Resolution Method in Propositional Logic- First Order Logic- Incompleteness of Forward Chaining- Resolution Refutation in First Order Logic- Deductive Retrieval – Resolution Method's Complexity in FOL- Horn Clauses and SLD Resolution- Backward Chaining- Second Order Logic.	

Total : 45 Periods

G. Learning Resource

i. Text books:

1. "A First Course in Artificial Intelligence", Deepak Khemani, McGraw Hill Education, 2013.

ii. Reference books:

1. "Logic Foundations of Artificial Intelligence", Michael R. Genesereth,N.J.Nilsson, Morgan Kaufmann Publishers, 1st Ed, 1987.
2. "Understanding Beliefs", N.j.Nilsson, MIT Press, 2014.
3. "Search in Artificial intelligence", Kanal.L, et al, Springer-Verlag New York Inc.,1988.
4. "Artificial Intelligence", E. Rich and K. Knight, Mc Graw Hill Publishers Inc, 3rd Edition, 2017.
5. "Artificial intelligence P: A Modern Approach", S.J.Russell et al, PearsonEd India,3rd Ed, 2015.

iii. Online Resources:

1. <https://i4iam.files.wordpress.com%2F2013%2F08%2Fartificial-intelligence-by-rich-and-knight.pdf&usg=AOvVaw2A8-1FYIVizB7m-RiVXjhQ>
2. <https://nptel.ac.in/courses/109101003>
3. <https://nptel.ac.in/courses/109101004>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS307	Python Programming with Data Analytics Lab	0	0	4	2

Course Category: Program Elective

- **Preamble :**

Python is a very powerful programming language used for many different applications. Analyze data using Python will take you from the basics of Python to exploring many different types of data. Data Analysis libraries: will learn to use Pandas DataFrames, Numpy multi dimensional arrays, and SciPy libraries to work with a various datasets. We will introduce you to pandas, an open-source library, and we will use it to load, manipulate, analyze, and visualize cool datasets. Then we will introduce you to another open-source library, scikit-learn, and we will use some of its machine learning algorithms to build smart models and make cool predictions.

E. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving Using C

F. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS140	Machine Learning Techniques

D. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Demonstrated understanding of Python concepts	S3
CO2	Create and manipulate regular Python variables	S3
CO3	Implement the various oops concept and looping statements	S3
CO4	Demonstrated understanding of pandas, NumPy, and matplotlib concepts	S3
CO5	Demonstrate the various machine learning techniques using Scikit	S3

K2-Understand, K3-Apply, S3-Processes

E. Correlation of COs with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M							L						
CO2	M	M	M						L					L	
CO3	M	M	M		L			L	L		M	L	L	M	L
CO4	M	M	L	M	L			L	L		M	L	L	M	L
CO5	M	M	L	M	L			L	L		M	L	L	M	L

F. Course Content:

1. Simple python Applications
 - Understanding Types, Expressions and variables
 - Handling Strings in python
2. Data structures in python
 - Implement mutable variables(list ,set,dictionaries)
 - Implement immutable variable(tuple)
3. Conditional and looping statements in python
 - Simple applications using object oriented concepts
 - Implement looping statements (while,for..)
4. Scientific libraries in python
 - Use mathematic functions for scientific numerical operations by importing NumPy and SciPy libraries
 - Use Matplotlib to plot the 2D graph and images
 - Use Pandas for implementing Data Analysis
5. Machine Learning using python
 - Implement the supervised learning(classification) using Scikit
 - Implement unsupervised learning (clustering) using Scikit
6. Twitter data analysis
7. Sentimental analysis based on review
8. Mini project

Total : 60

G. Learning Resources:

ii. Reference Books:

- i. Mark Lutz, "Learning Python", 5th Edition, O'Reilly Media, 2013.
- ii. Wes McKinny "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2012.
- iii. Jake VanderPlas , "Python Data Science Handbook Essential Tools for Working with Data", O'Reilly Media, 2017.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS210	BIG DATA ANALYTICS AND TOOLS	2	0	2	3

Course Category: Program Elective

A. Preamble :This course covers foundational techniques and tools required for data science and big data analytics. The course focuses on concepts, principles, and techniques applicable to any technology environment and industry and establishes a baseline that can be enhanced by further formal training and additional real-world experience.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS107	Database Management Systems

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS118	Distributed and Parallel Computing

D. Course Educational Objectives :

Learners are exposed to

- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level
CO1	Differentiate traditional data processing with Big Data Analytics.	K2

CO2	Explain the technology landscape behind the Big Data Analytics using Hadoop and NoSQL	K2
CO3	Solve distributed computing challenges with the help of Hadoop and MongoDB.	K3
CO4	Perform CRUD operations using Cassandra and Hive	K3
CO5	Differentiate between Pig and Hive in terms of processing and to design JasperReports using Jaspersoft studio using data from NoSQL databases.	K3

F. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		H												
CO2	M			M											
CO3	M	M	H	M	M										
CO4	M	M	M		M						M				
CO5	M	H	M		M						M				

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Introduction to Digital Data and Big Data 6

Types of Digital Data - Structured Data - Semi-Structured Data - Unstructured Data. Characteristics of Data- Evolution of Big Data- Definition of Big Data - Challenges of Big Data- Other Characteristics of Data - Traits of Big Data- Traditional Business Intelligence (BI) versus Big Data- Typical Data Warehouse Environment- Typical Hadoop Environment- Realms of Big Data.

UNIT II Introduction to Big Data Analytics and Technology landscape 6

Big Data Analytics - Hype around Big Data Analytics- Classification of Analytics and Challenges on Big Data- Data Science- Data Scientist- -Terminologies Used in Big Data

Environments -Basically Available Soft State Eventual Consistency (BASE)- Analytics Tools. NoSQL (Not Only SQL)- Hadoop- Features and Advantages of Hadoop - Overview of Hadoop Ecosystems, Hadoop Distributions, Hadoop versus SQL, Integrated Hadoop Systems Offered by Leading Market Vendors - Cloud based Hadoop solutions.

UNIT III Introduction to Hadoop and MongoDB

6

Introducing Hadoop - RDBMS versus Hadoop- Distributed Computing Challenges - History of Hadoop - Hadoop Overview – Hadoop Distributors- Hadoop Distributed File System - HDFS - Processing Data with Hadoop - Managing Resources and Application with Hadoop YARN- Interacting with Hadoop Ecosystem. Introduction to MongoDB – JSON - Terms used in RDBMS and MongoDB - Data Types in MongoDB – MongoDB Query Language.

UNIT IV Introduction to Cassandra and Hive

6

Apache Cassandra- An Introduction- Features of Cassandra- CQL Data Types- CQLSH- Keyspaces- CRUD- Collections- Using a Counter -Time To Live (TTL) - Alter Commands - Import and Export- Querying System Tables- Practice Examples.

Introduction to Hive - Hive Architecture - Hive Data Types - Hive File Format- Hive Query Language- RCFILE Implementation –SerDe - UDF.

UNIT V Introduction to Pig and Jasper Report

6

Apache Pig - The Anatomy of Pig - Pig on Hadoop - Pig Philosophy - Use Case for Pig- ETL Processing - Pig Latin Overview - Data Types in Pig - HDFS Commands- Relational Operators- Complex Data Type - Piggy Bank- UDF (User Defined Function)- Parameter Substitution- Diagnostic Operator- Pig versus Hive- Hive Vs Pig.

Jasper Report using Jasper Soft - Introduction to Jasper Reports - Connecting to MongoDB NoSQL database- Connecting to Cassandra NoSQL Databases.

Lab Experiment:

L-15

1. Installation of Mongo DB with CRUD Operation in MongoDB
2. Mongo DB Query Language
3. Mongo DB with Java Connectivity

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4. Installation of Cassandra
5. CRUD Operation in Cassandra
6. Cassandra with Java Connectivity
7. Pig and Hive Query Language
8. Jasper Report -Connecting to Cassandra NoSQL Databases
9. JasperReports - Connecting to MongoDB NoSQL database
10. Single Node Hadoop Installation

TOTAL: 60

H. Learning Resources

i. Text Books

1. Seema Acharya and Subhashini C: Big Data and Analytics, First Edition, Wiley India Pvt. Ltd, 2015.
2. Judith Hurwitz, Alan Nugent,Fern Halper, Marcia Kaufman : Big data for dummies – Judith Hurwitz, Alan Nugent,Fern Halper, Marcia Kaufman, Wiley India Pvt. Ltd, April 2013.

ii. Reference Books:

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Tom White " Hadoop: The Definitive Guide" Third Edition, O'reilly Media, 2012.
3. Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos, "UnderstandingBig Data: Analytics for Enterprise Class Hadoop and Streaming Data", McGrawHill Publishing, 2012
4. Big Data: A Revolution That Will Transform How We Live, Work, and Think by Viktor Mayer-Schoenberger& Kenneth Cukier

5. MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems

iii. Web References

1. <http://tdan.com/matching-unstructured-data-and-structured-data/5009>
2. <https://www.mongodb.com/>
3. <http://cassandra.apache.org/>
4. <https://hadoop.apache.org/docs/r2.8.0/hadoop-mapreduce-client/hadoop-mapreduce-client-core/MapReduceTutorial.html>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS216	3D ANIMATION	2	0	2	3

Course Category: Program Elective

- A. Preamble:** To introduce a basic idea of 3D animation and identify suitable techniques for different real time applications

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1.	1151CS113	Computer Graphics and Image Processing

C. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)									
		Level of learning domain (Based on revised Bloom's taxonomy)									
CO1	Know the basic concepts of 3D animation	K2									
CO2	Identify the different modelling techniques	K2									
CO3	Explain the importance of various lighting techniques	K2									
CO4	Discuss various color, texture and surface styles	K2									
CO5	Familiarize the concept of animation keys	K2									

K1–Remember, K2–Understand, K3–Apply, K4–Analysis, K5–Evaluate, K6–Create

D. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M		M					M	M			L	
CO2	M	L			M						M			L	
CO3	M	M	H		M						M			L	
CO4	M	M	M		M					M	M			L	
CO5	M	L			M					M	M			L	

H- High; M-Medium; L-Low

E. Course Content

UNIT I

9

Introduction to 3ds Max, navigating 3D space, Creating geometry, Transforms, Modifiers, Animation basics, Light and cameras, Material Editor, Materials, and Maps, Rendering, Effects and Environments

UNIT II 9

Conceptualizing 3D coordinate systems. How to construct 3D models using various tools. Props Modeling. Advancement Environment and Set Design, Advancement Modeling and Texturing Environments and Sets, Advancement Lighting Considerations and Techniques

UNIT III 9

Tips and tricks for good lighting: Standard sunlight system, faking bounced light, daylight system, angle of incidence, attenuation, exposure control, photometric lights, radiosity, standard lights with scan line rendering,

UNIT IV 9

Color, Texture and surface styles: The Material Editor, colors and patterns in materials, multiple materials on single objects, lofting the materials, mapping coordinates, materials, multi/sub-object materials, procedural maps

UNIT V 9

ANIMATION KEYS: Concepts of Time In Animation, Working With The Max Animation Tool, Getting Started The Animation In Max, Using Controllers To Animate, Using The Track View To Animate, Using Dummy Objects, Animating Hierarchies, Creating Key frames, Auto Key frames, Move & Scale Key frame on the timeline, Animating with constraints & simple controllers, animation Modifiers & complex controllers, function curves in the track view, motion mixer Software: Autodesk 3Ds max

Total : 45

F. Learning Resources

i. Textbook:

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1. Tickoo, S. (2016). Autodesk 3ds Max 2017: a comprehensive guide. Schererville: CADCIM Technologies.
2. Smith, B. L. (2012). 3ds max design architectural visualization: for intermediate users. Waltham, MA: Focal Press.
3. Murdock, K. (2016). Kelly L. Murdock's 3ds Max 2017 complete reference guide. Mission, KS: SDC Publications.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS212	IMAGE PROCESSING FOR REMOTE SENSING	3	0	2	4

Course Category: Program Elective

A. Preamble:

The aim of the course is to introduce various techniques of processing and information extraction from remotely sensed images.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1		Computer Graphics and Image Processing

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS124	Soft computing
2	1152CS140	Machine Learning Techniques

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the fundamental concepts in remote sensing	K2
CO2	Apply appropriate radiometric and geometric image correction techniques.	K3
CO3	Apply and analyse various image enhancement techniques on remotely sensed data	K3
CO4	Understand various image classification techniques using machine vision algorithms	K2
CO5	Analyse high-dimensional remote sensing imagery (hyperspectral imagery and texture transforms) for Land Use Land Cover applications	K3

E. Correlation of COs with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L											L	
CO2	M		L		M								L		
CO3	M										L		L		
CO4	M	L	M		M						L			L	
CO5	M	L			M						L				

F. Course Content:

Unit I Introduction to Remote Sensing

9

Digital image, DIP system: components and functions, basic imaging process, multi-concept in Remote Sensing data analysis, Elements of human and computer assisted interpretation. Formats of digital imagery, colour look up tables.

Unit II Preprocessing of Remotely Sensed Images

9

Geometric distortions and their correction Sources of image geometry errors, altitude, attitude, velocity, earth rotation, map projection, panoramic and Correction of geometric distortions: model based correction, ground control points, mapping Polynomials, geo-referencing, registration, re-sampling, intensity interpolation.

Radiometric distortions and their correction Sources of radiometric distortion, atmospheric effects on remote sensing imagery, correction of radiometric distortions.

Unit III Image Enhancement

9

Image histogram, point operations and look-up tables, False Colour Composite (FCC), Density slicing, contrast enhancements, histogram equalization. Spatial and frequency filtering, linear filters, smoothing, sharpening, High/Low pass filters. Edge detection and enhancement: Edge Detection operators (Conventional filters): First derivative, Edge thinning and linking.

Unit IV Pattern Recognition

9

Pattern, image classification, decision surfaces. Unsupervised classification: K-means clustering, Supervised classification: Maximum likelihood, and minimum distance to means, K-NN, CNN, RNN. Training areas and their characteristics, sampling, refinement of training data. Feature selection: Bhattacharya and Mahalanobis distance. Classification accuracy estimation, Naïve measure, Kappa.

Unit V Case Study

9

Land use Land cover applications- Agriculture- road map detection- disaster management- change detection – analysis using ERDAS imagine software

THEORY TOTAL: 45 Periods

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F. LIST OF EXPERIMENTS**LAB TOTAL: 30 Periods**

1. Segment/Object-based classification
2. Pre-processing of RS data
3. ANN classification
4. Feature selection
5. Land Use Land Cover data analysis

G. Learning Recourses:**i. Text Book**

1. Lilles and, T.M., Kiefer, R.W. and Chapman, J.W., "Remote Sensing and Image Interpretation", (7th Ed.), John Wiley & Sons, 2015.
2. Jarocińska, Anna, van der Meer, Freek D., "Remote Sensing and Digital Image Processing", Springer, 2016.
3. John Jensen, "*Introductory Digital Image processing: A Remote Sensing Perspective*", 4rd edition, Prentice Hall.

ii. Reference Book

1. Robert Schowengerdt , "*Remote Sensing: Models and Methods for Image processing*", 3rd edition, Elsevier. ISBN: 0-12-369407-8, 2007.
2. Gonzalez, Rafael C. and Richard E. Woods "*Digital Image Processing*", 3rd Edition, Pearson Education, London.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS163	SMARTPHONE COMPUTING	3	0	0	3

Course Category: Program Elective

A. Preamble: The course aims at providing a sound conceptual foundation in the working principle of Smart phone which involves mobile communication, mobile hardware, and mobile software. The course attempts to provide the concept of localization, Mobile Sensing application and the importance of privacy and security in Smart phone. At the end of this course, students should be able to conceptualize, analyze and design of smart phone systems and Mobile cloud applications.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1151CS117	Java Programming

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Illustrate the Smart phone system architecture and its characteristics	K2
CO2	Understand the various Mobile Programming Platforms.	K2
CO3	Interpret the Mobile System Localization.	K2
CO4	Analyze the various Context Aware and Mobile Sensing techniques in Smartphone.	K3
CO5	Design the various Mobile Cloud Application	K3

E. Correlation of COs with POs and PSOs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M						M	M							
CO2	M	H	M					M						M	
CO3		H	M				M								
CO4	M	H	M	M											
CO5	M		H	H										M	H

H- High; M-Medium; L-Low

F. Course Content :

Mobile computing, Challenges in mobile computing, convergence of sensing, computing, and communications, Introduction to Smart phones Architecture, Overview of Mobility models, Augmenting Mobile 4G with WiFi, Vehicular WiFi Hotspots, Code Offload, Authentication on Mobile Phones, Activity based Password, Finger Taps usage as Fingerprints.

UNIT II Programming Platforms 9

Overview of different mobile programming environments, classical programming practices, Introduction to mobile operating systems: iOS, Android, Windows, Mobile application development. Wireless Energy Management: Measurement of energy consumption, WiFi Power Save Mode (PSM), Constant Awake Mode (CAM), Different Sleep States, WiFi Energy management.

UNIT III Localization 9

User location and tracking system, Cell tower localization, Spot localization, Logical location, Ambience fingerprinting, War-driving, Localization without war-driving, Indoor localization, Crowd sourcing for localization. Location Privacy: Different approaches, K-anonymity, CliqueCloak, Location Privacy, Applications with location proof.

UNIT IV Context Aware and Mobile Sensing 9

Context-Aware system, Context Aware Mobile Sensors, Automatic Image Tagging, Safety critical applications, Energy-efficient Context Sensing, Contextual Ads and Mobile Apps, Context aware security. Mobile Sensing: Machine Recognition of Human Activities, Mobile Phones to Write in Air, Personalized Gesture Recognition, Content Rating, Recognizing Human without Face Recognition, Intelligent transportation, crowd-sourcing applications, Phone-to-Phone Action Games, Interface design issues, Gesture-based Input.

UNIT V Mobile Cloud Computing 9

Mobile Cloud Computing, Mobile Cloud Service Models, Offloading Mobile Application to Cloud, Case Study: Mobile Commerce, Mobile-Cloud Social networking, Mobile-Cloud Healthcare.

TOTAL : 45 Periods

G. Learning Resources

i. Text Books:

1. PeiZheng, Lionel Ni, Morgan Kaufmann Series in Networking, Smart Phone and Next Generation Mobile Computing, Elsevier Science, First Edition, 2005.
2. Dijiang Huang Huijun Wu, Mobile Cloud Computing Foundation and Service Models, Elsevier Science, First Edition, 2017.

ii. References:

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.
3. Hansmann, LotharMerk, Martin Niclous, Stober, Principles of Mobile Computing, Springer second edition, 2006.

iii. Online Resources

1. Android Developers : {HYPERLINK "http://developer.android.com/index.html"}.
2. Apple Developer : <https://developer.apple.com/>
3. Windows Phone Dev Center : {HYPERLINK "http://developer.windowsphone.com"}
4. BlackBerry Developer : {HYPERLINK "http://developer.blackberry.com/"}

Course Code	Course Title	L	T	P	C
1152CS164	REINFORCEMENT LEARNING	3	0	0	3

A. Preamble:

- To provide a clear and simple account of the key ideas and algorithms of reinforcement learning.
- To explore how the learning is valuable to achieve goals in the real world.
- To explore about how Reinforcement learning algorithms perform better and better in more ambiguous, real-life environments while choosing from an arbitrary number of possible actions, rather than from the limited options of a video game.

B. Pre-requisite

Sl. No	Course	Course Name

	Code	
1	1151CS107	Database Management System

C. Link to Other courses

Sl. No	Course Code	Course Name
1	1152CS137	Artificial Intelligence
2	1152CS140	Machine Learning Techniques

D. Course Outcomes

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the need for machine learning for various problem solving	K2
CO2	Familiarize the basics of Reinforcement Learning	K2
CO3	Explain various tabular solution methods	K2
CO4	Familiarize in approximate solution methods	K2
CO5	Explain about classic conditioning and explore few applications	K2

E. Correlation of COs with POs :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H														
CO2	H	H													
CO3	H	H	M										L		
CO4	H	L	M										L		
CO5	M	M										M			

H- High; M-Medium; L-Low

F. Course Content

Unit-I Introduction to Machine Learning

8

Learning Problems – Perspectives and Issues – Concept Learning – Version Spaces and Candidate Eliminations – Inductive bias – Decision Tree learning – Representation – Algorithm – Heuristic Space Search.

Unit -II Introduction to Reinforcement Learning and optimization

9

Reinforcement Learning: Introduction - Elements of Reinforcement Learning - Limitations and Scope- An Extended Example: Tic-Tac-Toe- Multi-armed Bandits: K {PAGE }

armed, test beds, incremental implementation, Optimal initialization- Gradient Bandit, associative Search.

Unit- III Basic Tabular Solution Methods 10

Finite Markov Decision Processes- Goals, Rewards, Returns, Episodes- Optimal policies and optimal valued functions. **Dynamic Programming**: Policy Evaluation (Prediction) - Policy Improvement - Policy Iteration - Value Iteration- Asynchronous Dynamic Programming - Generalized Policy Iteration. **Monte Carlo Methods**: Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control - Monte Carlo Control without Exploring Starts - Off-policy Prediction via Importance Sampling. **Temporal-Difference Learning**: TD Prediction - Advantages of TD - Incremental Implementation - Off-policy Monte Carlo Control.

Unit IV -Approximate Solution Methods 9

On-policy Prediction with Approximation : Value-function Approximation -The Prediction Objective (VE) - Stochastic-gradient and Semi-gradient Methods - Linear Methods -Feature Construction for Linear Methods- Nonlinear Function Approximation: Artificial Neural Networks - Least-Squares TD - Memory-based Function Approximation - Kernel-based Function Approximation

Unit-V Classical Conditioning & Case studies

Classical Conditioning : Blocking and Higher-order Conditioning -The Rescorla-Wagner Model - TD Model -Simulations - Instrumental Conditioning - Delayed Reinforcement- Cognitive Maps. **Case Studies**: Samuel's Checkers Player, Optimizing Memory Control, Human-level Video Game Play- Autonomous UAV Navigation and path planning -Drones for Field Coverage

Total : 45 periods

Text books:

1. Richard S.Sutton and Andrew G. Barto, “ Introduction to Reinforcement Learning”, 2nd Edition, MIT Press, 2017.
2. Tom M. Mitchell, —Machine Learning, McGraw-Hill Education (India) Private Limited, 2013.

Reference books:

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1. Sigaud O. & Buffet O. "Markov Decision Processes in Artificial Intelligence", editors, ISTE Ltd., Wiley and Sons Inc, 2010.
2. Draguna Vrabie, Kyriakos G. Vamvoudakis , Frank L. Lewis. "Optimal Adaptive Control and Differential Games by Reinforcement Learning Principles " 2012.

Web References:

1. B. Zhang, Z. Mao, W. Liu, and J. Liu, "Geometric reinforcement learning for path planning of uavs," Journal of Intelligent & Robotic Systems, vol. 77, no. 2, pp. 391–409, 2015.
2. Huy Xuan Pham, Hung Manh La, David Feil-Seifer, Luan Van Nguyen, "Cooperative and Distributed Reinforcement Learning of Drones for Field Coverage", arXiv:1803.07250v1 [cs.RO] ,20 Mar 2018.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS165	COGNITIVE SCIENCE	3	0	0	3

Course Category: Program Elective

A. Preamble :

To provide an introduction to the cognitive science, explore the underlying cognitive mechanisms for higher order process and to realize aspects of human cognition on machine.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving Using C

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS137	{HYPERLINK "http://vlearn.veltech.edu.in/course/view.php?id=2768"}
2	1152CS140	{HYPERLINK "http://vlearn.veltech.edu.in/course/view.php?id=2771"}

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Familiarize with basic concepts of cognitive science	K2
CO2	Explore the internal mental process of human	K2
CO3	Understand emergence of language abilities from cognition perspective	K2
CO4	Understand the basic concepts and techniques of computational cognitive model	K2
CO5	Design and execute a project that leverages cognitive computing	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H						L				L	M	L	L	
CO2	H	L	L				L				L	L	M		L
CO3	H	M	L			L		L			L	L	L	M	
CO4	H	M	L			L		L			L	L	L	L	M
CO5	H	M	M			M		L			M	L	M	M	H

H- High; M-Medium; L-Low

F. Course Content :

UNIT I FOUNDATION OF COGNITIVE SCIENCE

L-8

{PAGE }

The Cognitive view -Benefits of cognitive science -The Interdisciplinary Nature of Cognitive Science - The Philosophical Approach - The Psychological Approach - The Neuroscience Approach-The Linguistic Approach - The Artificial Intelligence Approach

UNIT II COGNITIVE PSYCHOLOGY

L-10

Cognitive Psychology –The Nature of Cognitive Psychology- A GlobalView of Cognitive Architecture–Representation: Proportional representation-Schematic representation-Attention-The Acquisition of Skill- Memory-Reasoning – Problem solving

UNIT III LANGUAGE AND COGNITIVE SCIENCE

L-10

The Linguistic Approach: The Importance of Language - The Nature of Language- Language Acquisition- Philosophy and Linguistics- Cognition and Linguistics- Neuroscience and Linguistics- Artificial Intelligence and Linguistics: Natural language processing-Speech recognition

UNIT IV COMPUTATIONAL MODELS OF COGNITION

L-8

Modeling Paradigms -Connectionist models of cognition: Key Properties of Connectionist Models-Neural Plausibility- Three Illustrative Models- Bayesian models of cognition - Dynamical systems approach to cognition.

UNIT V COGNITIVE COMPUTING

L-9

Cognitive Computing- Foundation of Cognitive Computing -Elements of Cognitive System- -Building Cognitive Applications - IBM Watson- DeepQA Architecture -Watson Corpus- Question Analysis-Sentiment analysis-Question Classification - Hypothesis Generation- Scoring and Confidence Estimation -Case Study: Cognitive Healthcare Application

TOTAL: 45

G. Learning Resources

i. Text Books:

1. Neil Stillings, Steven E. Weisler, Christopher H. Chase and Mark H. Feinstein , “Cognitive Science: An Introduction”, Second Edition.
 2. José Luis Bermúdez, “Cognitive Science: An Introduction to the Science of the Mind” , Cambridge University Press, New York,2010.

3. Ron Sun (ed.), "The Cambridge Handbook of Computational Psychology", Cambridge University Press,2008.
4. Judith S. Hurwit ,{HYPERLINK "<https://www.wiley.com/en-us/search?pq=%7Crelevance%7Cauthor%3AMarcia+Kaufman>"} and Adrian Bowles, "Cognitive Computing and Big Data Analytics", Wiley, 2015.

ii. References Books:

1. Robert L. Solso, Otto H. MacLin and M. Kimberly MacLin,"Cognitive Psychology", Pearson Education, 2007.
2. J. Friedenberg and G. Silverman, "Cognitive Science: An Introduction to the Study of Mind ",2006.
3. Carolyn Panzer Sobel and Paul Li, "Cognitive Science: An Interdisciplinary Approach" ,2013. Stuart Russell and {HYPERLINK "<http://www.norvig.com/>"} , "Artificial Intelligence: A Modern Approach", Third Edition, Prentice Hall,2009

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS166	WIRELESS SENSOR NETWORKS	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course is to provide students with a constructive overview of the concepts of wireless sensor networks with its standards and its protocols to design and create models for real world applications.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS209	Internet of Things

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Learn the fundamentals and architecture of wireless sensor networks.	K2
CO2	Understand the several protocols used in WSN for data disseminating and data gathering.	K2
CO3	Study the various types of algorithms and methods for data aggregation.	K2
CO4	Understand the agriculture applications constructing a system or model for agriculture productivity.	K2
CO5	Explain the industrial applications for constructing design a system or model for industrial monitoring and control.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H			L			L					L			M
CO2	M	H	M	H			L		L			M	L	L	M
CO3	H	H	M	M			L		L			M	L	L	M
CO4	M	L	H	M			M		L			H	M	M	H
CO5	M	L	H	H			M		L			H	M	M	H

H- High; M-Medium; L-Low

F. Course Content :

UNIT I Introduction to WSN 9

Overview of WSN, Technological background, Network architecture, Classification of WSN, Protocols stack for WSN, Fundamental MAC protocols.

UNIT II Routing, Data Dissemination and Data Gathering 9

Fundamentals and Challenges, Taxonomy of routing and Protocols, Location aided protocols, Data gathering protocols, Data centric protocols and Multipath – based protocols.

UNIT III Data Aggregation and Energy Issues 9

Introduction, Node clustering algorithm for WSN, Query processing in WSN, Data aggregation in WSN, Need of energy efficiency and Power control in WSN and Future directions.

UNIT IV Agricultural WSN 9

Introduction, Potential applications, Design of WSN for agriculture applications, Technological and standards, Existing Real-world applications, Future challenges and Issues.

UNIT V Industrial WSN 9

Introduction to IoT and IIoT, Challenges and Issues, IIoT Technologies and its standards, IIoT protocols, Security and privacy in IIoT, Future directions.

TOTAL: 45

G. Learning Resources

i. Text Books

1. Jun Zheng and Abbas Jamalipour, —Wireless Sensor Networks: A Networking Perspective”, 1st Edition, A John Wiley & Sons, Inc., Pub. 2009.
2. Tamoghna Ojha, Sudip Misra, Narendra Singh Raghuvanshi, “Wireless sensor networks for agriculture: The state-of-the-art in practice”, Computers and Electronics in Agriculture, Science Direct, 2015.

3. Ramakrishna Budampati and Soumitri Kolavennu, "Industrial Wireless Sensor Networks Monitoring, Control and Automation", Woodhead Publishing Series in Electronic and Optical Materials, 2015.

ii. References

1. Dr. Kazem Sohraby, {HYPERLINK "https://onlinelibrary.wiley.com/action/doSearch?ContribAuthorStored=Minoli%2C+Daniel" \o "Daniel Minoli"}, Taieb Znati, Wireless Sensor Networks: Technology, Protocols, and Applications, John Wiley & Sons, Inc., 2007.
2. Ian F. Akyildiz and Mehmet Can Vuran, Wireless Sensor Networks, A John Wiley and Sons, Ltd, Publication, 2010.

iii. Online Resources

1. <https://www.sciencedirect.com/book/9781782422303/industrial-wireless-sensor-networks#book-info>.
 2. {HYPERLINK "http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02"}.
- {HYPERLINK "http://doktora.kirbas.com/Kitaplar/Wireless%20Sensor%20Networks%20(Akyildiz).pdf"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS167	COMPUTATIONAL THINKING	3	0	0	3

Course Category: Program Elective

A. Preamble:

Working with data requires extensive computing skills. A Data Science student must be prepared to work with data as they are commonly found in the workplace and research labs. For example, accessing and organizing data in databases, scraping data from websites, processing text into data that can be analyze and ensuring secure and confidential data storage all require extensive computing skills.

B. Pre-requisites:

Sl No	Course Code	Course Name
1	1151CS102	Data Structures
2	1151CS106	Design and Analysis of Algorithms
3	1151CS119	Introduction to Design and Analysis of Algorithms

C. Related Courses:

Sl No	Course Code	Course Name
1	1152CS110	Knowledge based decision support systems
2	1152CS206	{HYPERLINK "file:///C:/\Multimedia\\Desktop\BoS\course-faculty%20list.xlsx" \1 "Sheet1!statisticalMethods"}

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand problems drawn from real-world scenarios by interpreting and evaluating data	K2
CO2	Explain computational thinking to solve problems, and determine what insight can be gained	K2
CO3	Identify concepts that make computing using statistical concepts	K2
CO4	Demonstrate how computations can be viewed as an alternative to theory and experiments in scientific research	K2

	using knapsack	
CO5	Explain some of the logic behind existing computational approaches for various problems of interest to science and society	K2

E. Correlation of Cos with Pos :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L								L	H	L	M	L	
CO2	M		M	M	L							H	H		L
CO3	M	M								M			M	L	
CO4	M		M	M	M						L	M	L		
CO5	M	L	M	M	M					L	M		L		L

H- High; M-Medium; L-Low

F. Course content:

Unit-I Stochastic Programs, Probability and Statistics 9

Stochastic Programs-Inferential statistics and simulation-Distributions- Normal distribution and confidence levels-Uniform distributions-Exponential and Geometric distributions-Bedford's distribution

Unit- II Random Walk and data visualization 9

Drunkards Walk, Biased Random walks, Treacherous fields-Pascal's Problem- pass or Don't pass

Unit-III Lies and Statistics 9

Garbage In Garbage Out (GIGO)-sampling bias-context Matters-Beware of extrapolation-the Texas sharpshooter Fallacy- just beware

Unit-IV Knapsack and Graph optimization problems 9

Knapsack problems-Greedy algorithms-an optimal solution to knapsack problem-graph optimization problems-shortest path-DFS-BFS-Dynamic Programming-Fibonacci sequence – divide and conquers

Unit-V Quick look on Machine Learning 9

Feature vectors-Distance Metrics- Clustering- K-means Clustering- A contrived Example- Wrapping up

G. Learning Resources

i. Text Book

1. Guttag, John. Introduction to Computation and Programming Using Python: With Application to Understanding Data. 2nd ed. MIT Press, 2016.
2. Ethem Alpaydin. Introduction to Machine Learning, second edition, The MIT Press, 2010.

ii. Reference books

1. Introduction to computational thinking Kindle Edition by The Open University The Open University; 1.0 edition, 2016.

iii. Online Resources

1. {HYPERLINK "https://mitpress.mit.edu/books/introduction-computation-and-programming-using-python-revised-and-expanded-edition"}
2. {HYPERLINK "https://www.edx.org/course/introduction-computational-thinking-data-mitx-6-00-2x-7"}
3. <https://www.pearson.com/us/higher-education/program/Guzdial-Introduction-to-Computing-and-Programming-in-Python-plus-My-Lab-Programming-with-Pearson-e-Text-Access-Card-Package-4th-Edition/PGM239876.html>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS168	WIRELESS BODY AREA NETWORKS	3	0	0	3

Course Category: Program Elective

A. Preamble:

The main purpose of this course is to provide in-depth knowledge of wireless body area networks and antenna system.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	{HYPERLINK "file:///C:\\\\Users\\\\ADMINI~1\\\\AppData\\\\Local\\\\Temp\\\\Rar\$DI85.365\\\\1152CS168.doc" \\1 "de"} Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain about the basic supporting system for wireless body area networks	K2
CO2	Discuss about Network and Medium Access Control Protocol design for WBAN.	K2
CO3	Explain about Power Management in Body Area Networks for Health Care.	K2
CO4	Discuss about the applications of WBAN.	K2
CO5	Explain about Wearable Systems.	K2

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M														
CO2	M	L													L
CO3	M	L	L		L						L				L
CO4	M	L	L		L						L				L
CO5	M	L									L				L

H- Strong; M-Medium; L-Low

F. Course Content:

UNIT I: Supporting System for WBAN 9

Wireless body sensors-Sensor nodes and hardware designs-Wireless systems and platforms-Wireless transceivers and microcontrollers-Existing sensor boards-Design of implanted sensor nodes for WBAN-WBAN Systems-Software programs and monitoring.

UNIT II: Network and Medium Access Control Protocol Design for WBAN 9

Network topologies and configuration-Basics of MAC protocol-Traffic characteristics - Scheduled protocol- Random access protocol-Hybrid MAC protocol - Energy management in WBAN- Patient Monitoring Network Design - Performance analysis of WBAN.

UNIT III: Power Management in Body Area Networks for Health Care

The Case for Transmit Power Control in Body Area Networks: Normal Walk, Slow Walk, Resting, Optimal Off-Line Transmit Power Control, Practical On-Line Transmit Power Control: A Simple and Flexible Class of Schemes, Example Adaptations of the General Scheme, Tuning the Parameters.

UNIT IV: Applications of WBAN 9

Monitoring patients with chronic disease, Hospital patients, Elderly patients, Cardiac arrhythmias monitoring, Multi patient monitoring systems, Multichannel Neural recording, Gait analysis, SportsMedicine, Electronic pill.

Need for Wearable Systems, Applications of Wearable Systems, Recent developments – Global and Indian Scenario, Types of Wearable Systems, Components of wearable Systems, Physiological Parameters commonly monitored in wearable applications, Smart textiles, & textiles sensors, Wearable Systems for Disaster management.

TOTAL: 45**Learning Resources****i. Text Books:**

3. Huan-Bang Li, Kamyayekh Yazdandoost Bin-Zhen, "Wireless Body Area Networks", River Publishers, 2010.
4. Mehmet R. Yuce, Jamil Y.Khan, "Wireless Body Area Networks Technology, Implementation, and Applications", Pan Stanford Publishing Pte.Ltd, Singapore, 2012.
5. Annalisa Bonfiglio, Danilo De Rossi , "Wearable Monitoring Systems", Springer, 2011.

ii. Reference Books:

1. Terrance J. Dishongh and Michael McGrath, "Wireless Sensor Networks for Healthcare Applications", Artech House; First edition, October 30, 2009, ISBN – 978- 1596933057.
2. Guang-Zhong Yang (Editor), and M. Yacoub (Foreword), "Body Sensor Networks", Springer; First Edition, March 28, 2006, ISBN-13: 978- 1846282720.
3. Huan-Bang Li, Kamyayekh Yazdandoost, and Bin Zhen, "Wireless Body Area Network", River Publishers' Series in Information Science and Technology, Oct 29, 2010, ISBN : 978-87-92329-46-2.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS213	MULTIAGENT SYSTEM DESIGN	3	0	2	4

Course Category: Program Elective

A. Preamble :

Ability to formulate a problem in logical terms and basic knowledge of logical inference, decision making, algorithmic complexity and multi agent system.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS117	Java Programming
2	1151CS106	Design and Analysis of Algorithm
3	1151CS119	Introduction to Design and Analysis of Algorithms

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the origins and foundations of Agent Orientation in distributed computing	K2
CO2	Apply the possible knowledge and reasoning to multi-agent system for simple and complex decision making process	K3
CO3	Analyze the interactions and communications in multi-agent system using agent-oriented methodologies	K3

CO4	Evaluate the coordination and decision making process using social models in distributed robust applications.	K3
CO5	Create the agent based industrial and practical applications by applying methodology and tool related to competences.	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	M									L	L	L	L
CO2	M	M	H	H	L							M	M	M	M
CO3	M	H	H	H	H							M	H	H	M
CO4	M	H	H	H	L	H						M	M	H	M
CO5	M	M	H		H	H						H	H	H	H

F. Course Content:

UNIT I Introduction to Agent Orientation

9

Intelligent Agents: Introduction, Agents, Abstract Architectures for Intelligent Agents, Concrete Architectures for Intelligent Agents, Agent Programming Languages – Multi-agent Systems and Societies of Agents: Introduction, Agent Communications, Agent Interaction Protocols, Societies of Agents.

UNIT II Reasoning in Agents

9

Knowledge and reasoning: Agents that Reason Logical, First-Order Logic, Building a Knowledge Base, Inference in First-Order Logic, Logical Reasoning System - Uncertain knowledge and reasoning: Uncertain, Probabilistic Reasoning System, Making Simple Decisions, Making Complex Decisions.

UNIT III Multiagent Interaction, Communication & Methodologies

9

Multi-agent Interaction: Utilities and Preferences, Multi-agent Encounters, Dominant Strategies and Nash Equilibria, Competitive and Zero-Sum Interactions, The Prisoner's Dilemma, Other Symmetric 2 x 2 Interactions, Dependence Relations in Multi-agent Systems - Communication: Speech Acts, Agent Communication Languages, Ontologies for Agent Communication, Coordination Languages - Methodologies: Agent-Based Solution Appropriate, Agent-Oriented Analysis and Design Techniques, Pitfalls of Agent Development, Mobile Agents.

UNIT IV Coordination And Social Models

9

Working Together: Cooperative Distributed Problem Solving, Task Sharing and Result Sharing, Result Sharing, Combining Task and Result Sharing, Handling Inconsistency,

Coordination, Multi agent Planning and Synchronization - Distributed Rational Decision Making: Evaluation Criteria, Voting, Auctions, Bargaining, General Equilibrium Market Mechanisms, Contract Nets, Coalition Formation.

UNIT V Applications of Agent-Oriented Design

9

Application: Agents for Workflow and Business Process Management, Agents for Distributed Sensing, Agents for Information Retrieval and Management, Agents for Electronic Commerce, Agents for Human-Computer Interfaces, Agents for Virtual Environments, Agents for Social Simulation, Agents for X - Industrial and Practical Applications: Use DAI in Industry, Overview of the Industrial Life-Cycle, Life Cycle Are Agents Used, Industry Constrain the Life Cycle of an Agent-Based System, Development Tools.

TOTAL	: 45
LAB TOTAL	: 30

LIST OF EXPERIMENTS

1. Simple and composite behaviors usage model
2. JADE agents Messaging Service
3. Yellow Pages service Management
4. Topic-based message delivery mechanism
5. JADE for interaction protocols
6. Application specific ontology
7. Control a number of agents from an external application
8. Mobile agent development
9. Agent creates some other agents for simple conversation

Software Required: JADE Tool, Java Package

G. Learning Resources

Text Books:

3. Gerhard Weiss, "Multiagent Systems", MIT Press, Second Edition, 2013.
4. Michael Wooldridge, "An introduction to multiagent systems", John Wiley & Sons, Second Edition, 2009.
5. Stuart Russell, Peter Norvig, "Artificial Intelligence: a modern approach", Pearson Education, Third Edition, 2014.

ii. Reference Books:

1. M. Wooldridge, "Reasoning about Rational Agents", The MIT Press, 2000.
2. M. Huhns & M. Singh (Eds.), "Readings in Agents", Morgan Kaufmann, 1998.
3. J. Ferber, "Multi-Agent Systems", Addison-Wesley, 1999.

iii. Online Resources:

1. <http://agents.umbc.edu>
2. <http://jade.tilab.com> , <http://www.agentbuilder.com/AgentTools/>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS169	SECURE ENGINEERING SYSTEMS	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course is to provide students with an overview of the concepts of internet security, trusted systems, web security, E-commerce and Cloud securities.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	{HYPERLINK \l "IS"} Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	{HYPERLINK \l "CNS"}

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of security systems.	K2
CO2	Know the various models and services of internet security.	K2
CO3	Learn the various models, policies and services for secure systems.	K2
CO4	Describe the various security issues and discuss web based policies and methods.	K2
CO5	Understand current threats facing organizations that conduct business online and how to mitigate these challenges.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L				L						M			L
CO2	H	L				L						M	L	L	M
CO3	H	L				L						M	L	L	M
CO4	H	L				L						M	L	L	M
CO5	H	H				L						M	L	L	M

H- High; M-Medium; L-Low

F. Course Content :

UNIT I	INTRODUCTION	9
Threats, Vulnerabilities, Controls; Risk, Confidentiality, Integrity, Availability; Security policies, Security mechanisms; Assurance; Prevention, Detection, deterrence, Web Client Server Architecture, Internet Security Evolution.		
UNIT II	INTERNET SECURITY	9
Secure Internet Programming, Security development life cycle, Internet Security Standards and Internet Security Products, Trusted Internet Security services.		
UNIT III	TRUSTED SYSTEMS AND SECURITY POLICIES	9
Trusted System Design, Trusted OS, Secure System Models, Security in Networks: Network Security Controls, IDS, Firewalls, Secure E-Mail. Internet Security Policies: Web Server and Web Browser policies		
UNIT IV	WEB SECURITY	9
Security Issues, Real Threats that Impact Security, Securing the Web Client - Protecting Your Web Browser, Enhancing Web server security - Controlling Access, Extended Web Site Security Functionality, Securing Web Communications with SSL, VPNS.		
UNIT V	E-COMMERCE SECURITY	9
Survival requirements – Network Continuity Requirements – Threat Analysis – Technology solution- Operational Analysis – Survival Planning – Fixes – Remedies – Procedures – Survivability Today – Security Design for Cloud Computing: Secure Isolation- Comprehensive data protection - End-to-end access control - Monitoring and		

auditing- Quick look at CSA, NIST and ENISA guidelines for Cloud Security - Common attack vectors and threats.

TOTAL : 45 Periods

G. Learning Resources

(i) TEXT BOOKS

1. Charles Pfleeger and Shari Lawrence Pfleeger, "Security in Computing", Pearson Education Pvt Ltd, 5th Edition, 2015.

(ii). REFERENCES

1. Man Young Rhee, "Internet Security Cryptographic Principles, Algorithms and Protocols", John Wiley & Sons Ltd, 2003.
2. John R. Vacca, "Practical Internet Security", Springer, 2007.
3. Tim Mather,Subra Kumaraswamy,Shahed Latd," Cloud Security and Privacy " ,O'REILLY,2009.
4. Gary Schneider, Electronic Commerce, Sixth Edition, Course Technologies, 2006.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS170	INTRUSION DETECTION AND PREVENTION	3	0	0	3

Course Category: Program Elective

A. Preamble :

1. To provide a solid foundation to the students in network security and intrusion detection and prevention.
2. To enable the students to master the knowledge about intrusion detection and prevention in the context of real-life applications.
3. To prepare the students for understanding, evaluating critically, and assimilating new knowledge and emerging technology in network security

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the physical location, the operational characteristics and the various functions performed by the intrusion detection and prevention system.	K2
CO2	Describe how components in different layers inter-operate in the intrusion detection and prevention system.	K2

CO3	Learn new techniques and to align new security technologies to existing network infrastructure.	K2
CO4	Understand the current and effective architecture to deal with network security threats.	K2
CO5	Apply intrusion detection alerts and logs to distinguish attack by using SNORT tool.	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H							L							M
CO2		H	M	M				L					L		
CO3	H	M			H	M		M					M	M	
CO4			H	L		M		M					H	L	
CO5		H	H	H	H			M				M			H

H- High; M-Medium; L-Low

F. Course Content :

UNIT I INTRODUCTION 9

History of Intrusion detection, Audit, Concept and definition , Internal and external threats to data, attacks, Need and types of IDS, Information sources Host based information sources, Network based information sources.

UNIT II INTRUSION DETECTION AND NETWORK TRAFFIC SIGNATURE 9

Components of IDS, Steps of implementation and monitoring, Host- and network-based IDS, Implementing and evaluating IDS, intrusion detection versus intrusion prevention, Signature analysis, Detecting traffic signatures, Identifying suspicious events, Creating custom traffic signatures, Common Vulnerability and Exposures (CVE) standards

UNIT III INTRUSION DETECTION AND PREVENTION TECHNIQUES 9

Host-based intrusion detection system (IDS) / intrusion prevention system (IPS), network-based IDS/IPS. Data collection for IDS/IPS. Intrusion detection techniques, misuse detection: pattern matching, rule-based and state-based; anomaly detection: statistical based, machine learning based, data mining based; hybrid detection.

UNIT IV IDS and IPS ARCHITECTURE 9

Tiered architectures, single-tiered, multi-tiered, peer-to-peer. Sensor: sensor functions, sensor deployment and security. Agents: agent functions, agent deployment and security. Manager component: manager functions, manager deployment and security. Information flow in IDS and IPS, defending IDS/IPS

UNIT IV IDP TOOLS**9**

Introduction to Snort, Snort Installation Scenarios, Installing Snort, Running Snort on Multiple Network Interfaces, Snort Command Line Options. Step-By-Step Procedure to Compile and Install Snort Location of Snort Files, Snort Modes Snort Alert Modes

TOTAL : 45 Periods**G. Learning Resources****i . TEXT BOOKS**

1. Ali A. Ghorbani, Network intrusion detection and prevention concepts and techniques, Springer, 2010
2. C. Endorf, E. Schultz and J. Mellander, Intrusion Detection & Prevention, McGraw-Hill/Osborne, 2004.
3. Rafeeq Rehman : " Intrusion Detection with SNORT, Apache, MySQL, PHP and ACID," 1st Edition, Prentice Hall , 2003

ii . REFERENCES

1. Christopher Kruegel,Fredrik Valeur, Giovanni Vigna: "Intrusion Detection and Correlation Challenges and Solutions", 1st Edition, Springer, 2005.
2. Carl Endorf, Eugene Schultz and Jim Mellander " Intrusion Detection & Prevention", 1st Edition, Tata McGraw-Hill, 2004.
3. Stephen Northcutt, Judy Novak : "Network Intrusion Detection", 3rd Edition, New Riders Publishing, 2002

iii .ONLINE RESOURCES

1. <https://opensourceforu.com/2017/04/best-open-source-network-intrusion-detection-tools/>
2. <https://security.berkeley.edu/intrusion-detection-guideline>
3. <https://www.snort.org/>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS171	WIRELESS NETWORK SECURITY	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course discusses about the awareness of the network threats and the impact of security on intrusion attacks in the networks.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and Network Security

D. Course Educational Objectives:

Learners are exposed to

- Describe about the Intrusion detection and firewalls management.
- Know the concept of E-mail and web security protocols.
- Understand the working of wireless security protocols.
- Express the explicit IOT security protocols.
- Identify the depth of cloud security services.

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos .	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Describe about intrusion detection system and firewalls from preventing the system from security attacks.	K2
CO2	Discuss the process of E-mail security and web security protocols for data security services.	K2
CO3	Identify the wireless security protocols for wireless environment.	K2
CO4	Express the best suited security protocols for Internet of things security.	K2

CO5	Determine the cloud security services for secure data sharing.	K3
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F. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	M	L											M
CO2	M	M	M	M	M								L		M
CO3	M	L	M	M	M										M
CO4	M	M	M	H	H								L		M
CO5	M	M	M	H	H								L		M

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Introduction to Network Threats and Security

9

Threats in Networks – Network security controls - Intruders – Intrusion detection – password management – Malicious software – Firewalls: Characteristics – Types – Firewall basing – Firewall location and configurations.

UNIT II E-Mail and Web Security

9

Store and forward, Security Services, Source authentication, Message Integrity, Non-repudiation, proof of submission and delivery, pretty good privacy (PGP), Secure/Multipurpose Internet Mail Extension (S/MIME), Web security: Secure Socket Layer, Transport layer security – HTTPS – Secure Shell (SSH), IP Security: IP security policy, Encapsulating Security Payload.

UNIT III Wi-Fi Network Security

9

IEEE 802.11 wireless LAN overview IEEE standards, IEEE 802.11g, IEEE 802.11n – IEEE 802.11i wireless LAN security – Wireless Application Protocol – Wireless Physical Layer Security - Wireless Transport Layer Security – WAP end-to-end security.

UNIT IV IOT Security

9

IoT and cyber-physical systems - IoT security: Vulnerabilities, Attacks and Countermeasures) - Security engineering for IoT development - IoT security lifecycle - Security credential management system (SCMS) - PKI design - Certification provisioning - Pseudonyms (privacy-by design) - Misbehavior Detection - Revocation.

Cloud Information security objectives, Cloud Services, Cloud Security Design principles – Penetration testing tools and techniques – Cloud Computing risk issues: CIA Triad, privacy and Compliance Risks, Threats to infrastructure, Data and Access Control, Cloud Service Provider Risks – Case Studies on Cloud Security.

H. Learning Resources

i. Text Books:

1. William Stallings, "Cryptography and Network Security – Principles and Practice", Fifth Edition, Pearson Education, 2013.
2. Fei Hu, "Security and Privacy in Internet of Things (IoTs)," CRC Press, Taylor and Francis Group Publishing, 2016.
3. Ronald L Krutz and Russell Dean Vines, "Cloud Security – A comprehensive Guide to secure Cloud Computing", Wiley, 2016.

ii. Reference Books:

1. Bernard Menezes, "Network Security and Cryptography", Cengage Learning, 2014.
2. Bruce Schneier, "Applied Cryptography: Protocols, Algorithms and Source Code in C", John Wiley and Sons, 2013.
3. B. Rusell and D. Van Duren, "Practical Internet of Things Security," Packt Publishing, 2016.
4. Chalie Kaufman, Radia Perlman, Mike Speciner, "Network Security: Private communication in a public world", Pearson Education, 2007.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS172	DEEP LEARNING	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course provides an introduction to the basics of machine learning, neural networks, and Deep learning techniques. This course also provides the learning practice and acquires knowledge on deep learning tools.

B. Pre-requisites:

S1 No	Course Code	Course Name
1	1151CS101	{HYPERLINK \l "cm"}

C. Related Courses:

S1 No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the concepts of machine learning algorithms.	K2
CO2	Understand the fundamentals of neural networks.	K2
CO3	Explain the different Strategies and Perspectives of Deep learning fundamentals.	K2
CO4	Illustrate the concepts of CNN and RNN models.	K2
CO5	Apply the knowledge in deep learning tools.	K3

E. Correlation of COs with POs:

Cos	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3

CO1	M	L						L						M		L
CO2	M	L	L					M			H			M		L
CO3	M	L						M			L			M		L
CO4	M	L	L	L	M			M	M		L			M	M	L
CO5	L	L	L		H			H	M		H	L	L	M	M	M

H- High; M-Medium; L-Low

F. Course content:

UNIT I MACHINE LEARNING

9

Machine Learning - Examples of machine learning applications - Types of machine learning –

Supervised Learning: Classification - Decision Trees, Neural Networks – Unsupervised Learning: Clustering- Clustering Methods-Graph Clustering.

UNIT II FUNDAMENTALS OF NEURAL NETWORKS

9

Basics of Neural Networks- Neural network representation-History and cognitive basis of neural computation- Perceptrons- Perceptron Learning Algorithm- Multilayer Perceptrons (MLPs)- Representation Power of MLPs- Back Propagation.

UNIT III DEEP LEARNING FUNDAMENTALS AND STRATEGIES

9

Introduction to deep learning-History of Deep Learning- Perspectives and issues in deep learning – Deep Neural Networks - Unsupervised deep learning - Deep reinforcement learning - Deep learning strategies.

UNIT IV CNN and RNN

9

Foundations on CNN, Convolutional Neural Networks (CNNs): LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet- -Recurrent Neural Networks-Optimization in deep learning: Gradient Descent (GD) - Momentum Based GD.

UNIT V DEEP LEARNING TOOLS

9

CUDA ToolKit : Introduction, Programming Model, Programming interface, Performance Guidelines- NVIDIA- NVIDIA Architecture- Case Study : **Tensor Flow**, Caffe, Theano, Torch.

TOTAL: 45

G. Learning Resources

i. Text Books

1. Goodfellow, I., Bengio, Y., and Courville, A., "Deep Learning", MIT Press, 2016..
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 2014.
3. Li Deng and Ding Yu, "Deep Learning Methods and Applications", Now Publishers, 2014.

ii. Reference Books

1. Tom M Mitchell, "Machine Learning" , First Edition, McGraw Hill Education, 2013
2. Yegnanarayana, B , "Artificial Neural Networks", PHI Learning Pvt. Ltd, 2009.
3. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Education, 2004.
4. Christopher Bishop, "Pattern Recognition and Machine Learning" 2e, Springer, 2006.

iii. Digital Resources

1. {HYPERLINK "<http://www.deeplearningbook.org>"}
2. {HYPERLINK "<https://nptel.ac.in/courses/117105084/>"}
3. {HYPERLINK "https://en.wikipedia.org/wiki/Deep_learning"}
4. {HYPERLINK "https://en.wikipedia.org/wiki/Neural_network"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS173	ARTIFICIAL INTELLIGENCE AND FUZZY LOGIC	3	0	0	3

Course Category: Program Elective

A. Preamble:

Artificial intelligence and fuzzy logic deals with the development of intelligent information systems that can be used to solve well-defined problems such as Knowledge Acquisition and Machine Learning, Genetic programming, natural language processing Systems and fuzzy Logic and fuzzy control expert systems.

B. Pre-requisites:

Sl No	Course Code	Course Name
1	1151CS106	Design and Analysis of Algorithms
2	1151CS119	Introduction to Design and Analysis of Algorithms
3	1150CS201	Problem Solving Using C.

C. Related Courses:

Sl No	Course Code	Course Name
1	1152CS110	Knowledge based decision support systems
2	1152CS124	Soft Computing

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental concepts of AI and its applications and to familiarize the knowledge representation for solving agent based critical problems.	K2
CO2	Understand the concepts of rule based expert systems, Genetic programming and understand the overview of Natural language processing and its applications	K2
CO3	Apply the concepts of NLP algorithm and AI techniques using PROLOG and LISP	K3
CO4	Understand the overview of advanced fuzzy sets based on genetic algorithm and neural networks applications	K2

CO5	Understand the fundamental concepts of Evolutionary and Stochastic techniques for AI and Fuzzy set applications.	K2
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E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	M	M	M		M						M		
CO2	H	M	M	M	M		M						M		
CO3	H	H	H	H	H				M				H	M	M
CO4	M	H	M	H	M		H						M		M
CO5	M	H	M	H	M		M						M		M

H- High; M-Medium; L-Low

F. Course content:

Unit-I Introduction to Artificial Intelligence 9

Artificial Intelligence: History and Applications-Knowledge representation - Propositional calculus, Predicate Calculus, Theorem proving by Resolution, Answer Extraction, AI Representational Schemes- Semantic Nets, Conceptual Dependency, Scripts, Frames, Introduction to Agent based problem solving.

Unit- II Introduction to Genetic Algorithm and NLP 9

Machine Learning- Symbol based and Connectionist, Social and Emergent models of learning, The Genetic Algorithm- Genetic Programming, Overview of Expert System Technology- Rule based Expert Systems, Introduction to Natural Language Processing - Applications of NLP.

Unit-III PROLOG and LISP 9

Languages and Programming Techniques for AI- Introduction to PROLOG and LISP, Search strategies and Logic Programming in LISP, Production System examples in PROLOG – 8 Queens Problem, Travelling Salesman Problem, Robot Traversal Problem.

UNIT-IV Introduction to advanced Fuzzy Sets 9

Fuzzy sets and Fuzzy logic: Introduction- Neuro -fuzzy systems -Fuzzy-GA systems- Support Vector Machines- Fuzzy belief networks - Artificial Immune Systems - particle swarm optimization .

Evolutionary and Stochastic techniques: Genetic Algorithm (GA), different operators of GA, analysis of selection operations, Hypothesis of building blocks, Schema theorem-Simulated annealing and Stochastic models, Boltzmann Machine, Applications- case studies.

G. Learning Resources**i. Text Book**

1. George.F.Luger, Artificial Intelligence- Structures and Strategies for Complex Problem Solving, 4/e, Pearson Education, 2002.
2. Goerge J Klir and Bo Yuan , Fuzzy sets and Fuzzy logic: Theory and Applications. Prentice Hall of India, 1997.

ii. Reference Book:

1. E. Rich, K.Khight, Artificial Intelligence, 2/e, Tata McGraw Hill
2. Winston. P. H, LISP, Addison Wesley.
3. Ivan Bratko, Prolog Programming for Artificial Intelligence, 3/e, Addison Wesley, 2000.
4. H.J. Zimmerman, Fuzzy Set theory and its Applications, 4th Edition, Kluwer Academic Publishers, 2001

1152CS174	GREEN COMPUTING	L 3	T 0	P 0	C 3
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Course Category: Program Elective

A. Preamble :

Student must know about basic energy management option in individual components such as CPUs, network interfaces, hard drives, memory and operating systems.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem solving using C

C. Course Educational Objectives :

Upon completion of the course, students should be able to:

- give an account of the concept green IT,
- give an account of environmental perspectives on IT use,
- give an account of standards and certifications related to sustainable IT products,
- describe green IT in relation to technology,
- relate green IT to sustainable development,
- evaluate IT use in relation to environmental perspectives,
- discuss how the choice of hardware and software can facilitate a more sustainable operation,
- use methods and tools to measure energy consumption

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	To understand the concepts of technologies that conform to low-power computation	K2
CO2	To understand green (power-efficient) technologies for components of one single computer, such as CPU, memory and disk, and appreciate cutting edge designs for these components	K2
CO3	To have a basic understanding of a variety of technologies applied in building a green system and to identify the various key sustainability and green IT trends	K2
CO4	To discuss the various laws, standards and protocols for regulating green IT	K2

CO5	Be able to use a range of tools to help monitor and design green systems	K3
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E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M					M	M								
CO2	M					M	H								
CO3	M					M	H							M	
CO4	M					H	H							M	H
CO5	M					H	H						L	M	H

H- High; M-Medium; L-Low

F. Course Content:

UNIT I FUNDAMENTALS

9

Green IT Fundamentals: Business, IT, and the Environment –Green computing: carbon foot print, scoop on power –Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

UNIT II GREEN ASSETS AND MODELING

9

Green Assets: Buildings, Data Centers, Networks, and Devices - Green Business Process Management: Modeling, Optimization, and Collaboration –Green Enterprise Architecture –Environmental Intelligence Green Supply Chains –Green Information Systems: Design and Development Models.

UNIT III GREEN FRAMEWORK

9

Virtualizing of IT systems –Role of electric utilities, Telecommuting, teleconferencing and teleporting –Materials recycling –Best ways for Green PC –Green Data center – Green Grid framework.

UNIT IV GREEN COMPLIANCE

9

Socio-cultural aspects of Green IT –Green Enterprise Transformation Roadmap –Green Compliance: Protocols, Standards, and Audits –Emergent Carbon Issues: Technologies and Future.

UNIT V CASE STUDIES

9

The Environmentally Responsible Business Strategies (ERBS) –Case Study Scenarios for Trial Runs – calculating the carbon footprint – greening mobile devices - CASE

STUDIES –Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

TOTAL: 45 periods

i) Text Books

1. Bhuvan Unhelkar, Green IT Strategies and Applications-Using Environmental Intelligence, CRC Press, June 2011
2. Woody Leonhard, Katherrine Murray, Green Home computing for dummies, August 2009.

ii) Reference Books:

1. Alin Gales, Michael Schaefer, Mike Ebbers, Green Data Center: steps for the Journey, Shoff/IBM rebook, 2011.
2. John Lamb, The Greening of IT, Pearson Education, 2009.
3. Jason Harris, Green Computing and Green IT-Best Practices on regulations & industry, Lulu.com, 2008.
4. Carl Speshocky, Empowering Green Initiatives with IT, John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), Green computing: Large Scale energy efficiency, CRC Press, 2012

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS309	APPLIED CRYPTOGRAPHY LAB	0	0	4	2

Course Category: Program Elective

A. Preamble:

This course describes the cryptography concepts and it will be implemented using gmp library. Also, this helps to support cryptographic algorithms like RSA, Elliptic Curve Cryptography and Diffie Hellman key exchange

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and Network Security

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS117	Information Security
2	1156CS601	Minor Project
3	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are expected to

- Learn fundamentals of cryptography algorithms.
- Understand the GNU MP Language libraries and standards.
- Acquire background on Euclid theorems, Fermat theorems and cryptographic algorithms.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Implement the cryptographic basic programs	S3
CO2	Implement the Euclid , Fermat and Extended Euclid Theorems	S3
CO3	Implement the RSA, Diffie Hellman key exchange and chat application	S3
CO4	Write the cryptographic protocols program in HLPSL language using AVISPA toolset.	S3

F. Correlation of COs with Program Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M				M										
CO2	M				H								L	M	
CO3	M		M		H								L	M	
CO4	M		M		H										

H- High; M-Medium; L-Low

G. Course Contents

List of Experiments

SNO Experiment Name

1. Gmp: Basic Programs
2. Euclid Algorithm
3. Extended Euclid Algorithm
4. Extended Euclid Algorithm with time
5. Inverse using Extended Euclid Algorithm
6. Fermat theorem
7. RSA Algorithm
8. Chat Application: (Client & Server)
9. Avispa Basic Programs
10. Diffie Hellman Key Exchange

H. Learning Resources:

i. Text Books:

1. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd ed, Pearson, 2007.
2. William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI, 4th ed, 2006.

ii. Reference Books:

1. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007.

iii. Online Resources:

1. <https://gmplib.org>
2. www.avispaproject.org

Course Code	Course Name	L	T	P	C
1152CS149	Probability and Queuing Theory	3	0	0	3

A. Preamble:

The students are able to obtain the knowledge of basic probability theory, standard distributions, random variables and queuing methods.

B. Prerequisite:

S.No	Course Code	Course Name
1	1150MA202	Engineering Mathematics I
2	1150MA103	Engineering Mathematics II

C. Course Outcomes :

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Determine the probability distributions of different types of random variables and statistical distributions.	K3
CO2	Calculate Probabilities, correlation co-efficient and regression lines of two dimensional random variables.	K2
CO3	Identify the nature of the Markov and Poisson processes and calculate Stationary and transition probabilities.	K3
CO4	Apply the concept of Markovian Queueing models in real-time problems under steady state conditions.	K3
CO5	Apply the concept of non-Markovian queues and networks of queues.	K3

K1-Remember; K2-Understand; K3-Apply; K4-Analyze; K5-Evaluate; K6>Create

D. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H	H									H		

CO2	H	H	M									H		
CO3	H	H		H								H		
CO4	H	H	M		H							H		
CO5	M	M	M	M								M		

H- High; M-Medium; L-Low

E. Course Content:

UNIT I One Dimensional Random Variables 9
Discrete and continuous random variables – moments – moment generating functions and their properties (conditional expectations, the markov inequality, the chebyshev inequality) – binomial, Poisson, geometric, uniform, exponential, normal distributions.

UNIT II Two Dimensional Random Variables 9
Joint distributions – marginal and conditional distributions – covariance – correlation and regression – transformation of random variables – central limit theorem (for IID random variables)

UNIT III Markov Processes and Markov Chains 9
Classification – stationary process (wide sense and strict sense) – Markov process – Markov chains – transition probabilities – limiting distributions – Poisson process.

UNIT IV Queueing Theory 9
Markovian models – birth and death queueing models – steady state results: single and multiple server queueing models – queues with finite waiting rooms – finite source models – Little's formula.

UNIT V Non-Markovian Queues and Queue Networks 9
M/G/1 queue – Pollaczek-Khintchine formula – series queues – open and closed networks.

Total: 45

F. Learning Resources

i. Text Books:

1. O. C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, Indian Reprint 2007. (Unit 1 & 2)

2. O. C. Ibe, "Markov Processes for Stochastic Modeling", Elsevier, 2009. (Unit 3)
3. D. Gross, John F. Shortle, James M. Thompson, Carl. M. Harris, "Fundamentals of Queueing Theory", Wiley Student Edition, 2013. (Unit 4 & 5)

ii. References Books:

1. S. Asmussen, "Applied Probability and Queueing Theory" (2nd Edn), Springer, Berlin, 2003.

iii. Online Resources:

1. Prof. Krishna Moorthy Sivalingam, "Probability and Queuing Theory", [Online] Available: {HYPERLINK "<https://nptel.ac.in/courses/106106048/17>"}. [Accessed: 25-May-2019]

COURSE CODE	COURSE NAME	L	T	P	C
1152CS224	Cyber Security	3	0	2	4

Course Category: Programme Elective

A. Preamble:

This course provides the skills in cyber security in view of cybercrime, cyber offences, frauds in mobile and wireless devices, handling techniques of cybercrime, organizational implications and cyber terrorism.

C. Prerequisite Courses:

S. No	Course Code	Course Name
1	1151CS111	Computer Networks

D. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS161	Cyber Forensics

E. Course Outcomes:

After successful completion of this course, the students are able to:

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CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Outline the threats and risks in cybercrime and cyber offences.	K2
CO2	Identify the frauds, attacks and security issues in mobile and wireless devices.	K2
CO3	Know the methods used in cybercrime.	K2
CO4	Apply the phishing techniques and organizational implications.	K3
CO5	Describe about Social, Political, Ethical and Psychological Dimensions of Cybercrime.	K2

K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6>Create

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L				L	L	L				L		L	
CO2	M	M				L	L	M				L			L
CO3	M	H				L	L	L				L	M	M	
CO4	M	H				L	L	L				L		M	
CO5	L	L				L	L								L

H- High; M-Medium; L-Low

G. Course Content

UNIT 1 Introduction

9

Introduction: Definition and Origins of the Word, Who are Cybercriminals?, Classifications of Cybercrimes, The Legal Perspectives, An Indian Perspective, A Global Perspectives. **Cyberoffenses:** Categories of Cybercrime, How Criminals Plan the Attacks, Social Engineering, Classification of Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets.

UNIT II Cybercrime: Mobile and Wireless Devices

9

Trends in Mobility: Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phone: **Mobile Devices:**

Security Implications for Organizations, Organizational Measures for Handling Mobile Devices-Related Security Issues, Laptops: Physical Security Countermeasures.

UNIT III Tools and Methods Used In Cybercrime 9

Introduction: Proxy Servers and Anonymizers, Password Cracking: Online Attacks, Offline Attacks, Strong, Weak and Random Passwords, Random Passwords.

Keyloggers and Spywares: Software Keyloggers, Hardware Keyloggers, Antikeylogger, Spywares. **Virus and Worms:** Trojan Horses and Backdoors, Steganography, SQL

Injection, Steps and Prevent SQL Injection Attacks, Buffer Overflow, Attacks on Wireless Networks: Theft of Internet Hours and Wi-Fi-based Frauds and Misuses.

UNIT IV Phishing and Organizational Implications 9

Phishing and Identity Theft: Phishing, Spear Phishing, Types of Phishing Scams, Phishing Toolkits and Spy Phishing, Phishing Countermeasures, Identity Theft (ID Theft). Organizational Implications. **Cost of Cybercrimes and IPR Issues:** Lessons for

Organizations, Web Threats for Organizations: The Evils and Perils. **Social Media**

Marketing: Security Risks and Perils for Organizations, Social Computing and the Associated Challenges for Organization, Protecting People's Privacy in the Organization

UNIT V Cyberterrorism 9

Introduction: Intellectual Property in the Cyberspace, Copyright, Patent, Trademarks, Trade Secret, Tirade Name, Domain Name. **Ethical Hackers:** Good Guys in Bad Land,

The Psychology, Mindset and Skills of Hackers and Other Cybercriminals, Sociology of Cybercriminals, Information Warfare.

G. Lab Experiments: 30

Task 1: Installation of VM work station and Kali Linux Operating System.

Task 2: Configure the web server to avoid network traffic using load balancing.

Task 3: Port Scanning using network mapper (nmap).

Task 4: Managing network traffic using wireshark tool.

Task 5: Identify the DNS Pharming attack.

Task 6: Apply steganography attack using OpenStego.

Task 7: Create and verify the virus file.

Task 8: Create Terminate and Stay Resident (TSR) program for identify the virus.

Task 9: Create and Monitor Honey Pot and Network Sniffing.

Task 10: SQL Injection.

Total =75

H. Learning Resources:

i. Text Book:

1. Nina Godbole, Sumit Belapure, "Cyber Security", Willey India, 2012.

ii. Reference Books:

1. Roger Grimes, "Hacking the Hacker", Wiley India, 2017.
2. Donaldson, S., Siegel, S., Williams, C.K., Aslam, A., "Enterprise Cybersecurity - How to Build a Successful Cyber defence Program against Advanced Threats", A-press, 2015.

iii. Online Resources:

1. Udemy.com, "The Complete Cyber Security Course: Hackers Exposed", 2018. [online]. Availabe: <https://www.udemy.com/the-complete-internet-security-privacy-course-volume-1/>, [Accessed: May 2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS146	Privacy and Security in Online Social Media	3	0	0	3

Course Category: Program Elective

A. Preamble

This course is providing the knowledge in social media, opportunities in social media, employment ability through social media, setting up with consideration, risks appearance and management with all the policies, privacy and security in social media.

B. Prerequisite Courses

Sl. No	Course Code	Course Name
1	1152CS158	Cyber Security

C. Related Courses

Sl. No	Course Code	Course Name
1	1152CS176	Cyber Law and Security Issues

D. Course Outcomes

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the concepts and opportunities of Social media.	K2
CO2	Discuss about employment activities and considerations for setup in social media.	K2
CO3	Know the risks and dark sides of social media.	K2

CO4	Explain the risk management, privacies and policy of social media.	K2
CO5	Identify the security methods to prevent the risks in social media	K2

K1–Remember, K2–Understand, K3–Apply, K4–Analysis, K5–Evaluate, K6–Create

E. Correlation of COs with POs

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M					L	L		L		L			
CO2	L	M													
CO3	M	M			L	L	L								
CO4	M	L	L		L	L	M						L		
CO5	M					L	L								

H- High; M-Medium; L-Low

F. Course Content

UNIT 1 : Introduction & Opportunities in Social Media

9

Introduction: Survey of Social Networks, Popular Social Networks: Facebook, Google+, Twitter, LinkedIn. Understanding social media, Different types and classifications, The value of social media, Cutting edge versus bleeding edge, The problems that come with social media, security issue, Taking the good with the bad. **Opportunities:** New methods of marketing to customers, Building social authority, Engaging customers, Sharing information, Getting the word out, Taking advantage of collective intelligence

UNIT II Employment and Considerations for Setting Up

9

Employment and social media: Using social media to find employees, Candidate screening, Using social media to find employment, Limiting personal information, Employees using social media, Allowing social media in the workplace. **Considerations for setting up social media:** Social media in organization, Identifying the audience, Internet versus intranet, Making the right decisions early, Approved representatives, Privacy, Training and policy.

UNIT III Risks and The Dark Side of Social Media

9

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Introduction :Being bold versus being overlooked, Good social media campaigns, Bad social media campaigns, Sometimes it's better to be overlooked, Social media hoaxes, The human factor, Content management, Promotion of social media. **The Dark Side of Social Media:** Public embarrassment, False information, Information leakage, Retention and archiving content, Backing up social media, Loss of data/equipment. Cybercrime, Social engineering, Hacked accounts.

UNIT IV : Security Policies 9

Security Policies : Access Control Policies: Authorization-Based Access Control Policies, Role-Based Access Control. Administration Policies, Identification and Authentication, Auditing a Database System, Views for Security. Policy Enforcement and Related Issues: SQL Extensions for Security, Query Modification, Discretionary Security and Database Functions, Data Privacy. **Security Policies for Online Social Networks (OSN):** Running Example, Access Control Policies, Filtering Policies, Admin Policies. Security Policy Specification: Policy Language, **Authorizations and Prohibitions:** Access Control Authorizations, Prohibitions, Admin Authorizations. Security Rules, **Security Rule Enforcement:** General Approach, Admin Request Evaluation, Access Request Evaluation.

UNIT V Confidentiality, Privacy & Trust for Social Media Data 9

Introduction: Confidentiality, Privacy and Trust (CPT) : Current Successes and Potential Failures, Motivation for a Framework, CPT Framework: Role of the Server, CPT Process, Advanced CPT, Trust, Privacy, and Confidentiality Inference Engines. **Confidentiality Management:** Our Approach to Privacy for Social Networks, Trust for Social Networks, Integrated System, CPT within the Context of Social Networks.

Total : 45

G. Learning Resources

i. Text Books

1. Michael Cross, "Social Media Security", Elsevier Inc., 2014. [Unit: 1, 2 & 3]
2. Bhavani Thuraisingham, Satyen Abrol, Raymond Heatherly, Murat Kantarcioglu, Vaibhav Khadilkar and Latifur Khan, "Analyzing and Securing Social Networks", CRC Press - Taylor & Francis Group, 2016. [Unit: 4, 5]

ii. Reference Books

1. Yaniv Altshuler, Yuval Elovici, Armin B. Cremers, Nadav Aharony and Alex Pentland, "Security and Privacy in Social Networks", Springer Science, 2013.

iii. Online Resources

1. nptel.ac.in, 2016, "Privacy and Security in Online Social Networks", [online] Available: {HYPERLINK "<https://nptel.ac.in/courses/106106146/>"} [Accessed : May 2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS161	Cyber Forensics	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will address methods to properly conduct a computer and/or network

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forensics investigation. It includes digital evidence collection and evaluation of network and host system intrusions with hands-on use of powerful forensic analysis tools.

B. Pre requisite Courses:

Sl. No	Course Code	Course Name
1	1151CS108	Operating System

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS176	Cyber Law and security Policies

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the need for investigation and the ethics of investigation	K2
CO2	Classify evidence and understand quality control procedures	K2
CO3	Demonstrate the acquisition of data in different file systems	K2
CO4	Infer and conduct basic Network forensic analysis and perform e-mail investigation	K2
CO5	Make use of forensic tools and perform various tasks with the help of tools	K3

K1–Remember, K2–Understand, K3–Apply, K4–Analysis, K5–Evaluate, K6–Create

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L			L	L	L		M							
CO2	M	L		L											
CO3	H			L								M			L
CO4	L	L	L	L	L			L						M	M
CO5	M		M		M							L		M	M

H- High; M-Medium; L-Low

F. Course Content:**UNIT I Introduction**

9

Introduction to Forensics-Elements of crime, Knowledge base needed for cyber forensics, The law and Cyber forensics, **The Investigative Process**-Code of Ethics, Ethics of Investigations, The Evidence, **Evidence Management**- Collection, Transport, Storage, access control, disposition.

UNIT-II Forensic Science

9

Principles and Methods: Scientific approach to Forensics, Identification and Classification of Evidence, **Location of Evidence**: Storage Media, Hard drives, Hardware Interfaces, Recovering Data, Media File Forensic Steps-**Forensic Analysis**: Planning, Case Notes and Reports, Quality Control.

UNIT III Data Acquisition

9

Windows and CLI Systems: File systems, Disk Drives, Solid-State storage devices-**File Structures**: Disk partitions, FAT disk, NTFS disk: MFT and File attributes, MFT structure for File data, Deleting NTFS files, Resilient file system- Windows Registry- Microsoft startup tasks-Virtual machines.

UNIT IV Network Forensics

9

Network forensics overview-Securing a Network- Developing procedures for network forensics-Investigating virtual networks-Examining Honeynet projects-**E-mail Investigations**: Role of client and server in E-mail, Investigating E-mail crimes and violations, E-mail Servers, E-mail Forensic tools.

UNIT V Forensics Tools

9

Evaluating Forensics Tool Needs- Tasks performed by forensics tools- **Forensics Software Tools**: Command-line forensic tools, Linux forensic tools- **Forensics Hardware Tools**: Forensic work station, Write-Blocker- Validating and Testing Forensics Software

Total: 45**G. Learning Resources****i. Text Books:**

1. Chuck Eastom, "Certified Cyber Forensics Professional Certification, McGraw Hill, July, 2017. [Unit 1 and 2]
2. Bill Nelson, Amelia Phillips and Chris Steuart, "Guide to Computer Forensics and Investigations", Cengage Learning, 6th edition, 2019. [Unit 3,4 and 5]

ii. Online Resources

1. Rochester Institute of Technology 'Computer Forensics' [Online] Available: {HYPERLINK "<https://www.edx.org/course/computer-forensics-3>"} [Accessed 22 May 2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS147	Internet Security	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course provides a number of threats and vulnerabilities of the Internet will be covered, including various vulnerabilities of TCP/IP protocols, denial of service (DOS), attacks on routing, attacks on DNS servers, TCP session hijacking, and so on. This course will also cover defending mechanisms, including intrusion detection, firewalls, tracing the source of attacks, anonymous communication, IPsec and virtual private network.

B. Perquisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS158	Cyber Security

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explore the fundamentals of internet security and Browser Characteristics.	K2
CO2	Identify various attacks and vulnerabilities in Physical and Data Link Layer.	K2
CO3	Discuss the security issues in network and transport layer.	K2
CO4	Outline various attacks in Application Layer	K2
CO5	Apply security mechanisms in various layers of Internet Protocol.	K3

K1–Remember, K2–Understand, K3–Apply, K4–Analysis, K5–Evaluate, K6–Create

E. Correlation of COs with POs :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M			L	L	L						M		
CO2	H	L	L			M							M		M
CO3	H	L				L	M	L					M		M
CO4	H	H	L					L					M		M
CO5	H	H	L		L			L				L	L		M

H- High; M-Medium; L-Low

F. Course Content :

UNIT I Introduction

9

Internet security and history: Malware and viruses-Spam, Phishing and Hacking-Digital Footprints-Unsecured Networks: Issues in connecting to unsecure network.

Secure Hotspot usage-Cookies: Types of Cookies, Malicious cookies, Benefits of removing cookies from computer-Using Google Chrome, Firefox, Internet Explorer.

UNIT II Physical Layer & Data Link Layer Attacks

9

Physical Layer Attacks: Jamming attacks- active and passive attack, Shannon's perfect secrecy, Secure communication over Noisy Channels, Channel Coding for secrecy. **Data**

Link Layer Attacks: ARP protocol- ARP cache poisoning-ARP Spoofing-Port Stealing-DHCP Attacks.

UNIT III Network Layer & Transport Layer Attacks 9

Network Layer Attacks: How packets are received, Packet Sniffing, Packet Spoofing, Snoofing, Endianness, Calculating Checksum. **Transport Layer Attacks:** How the TCP Protocol Works, SYN Flooding attacks, TCP Reset Attack, TCP Session Hijacking Attack.

UNIT IV Application Layer Attacks 9

Domain Name System Attacks: **DNS Hierarchy -DNS Attack Overview-Local and Remote cache poisoning attack.** Cross Site Request Forgery: **Cross Site Request and It's Problems.** SQL Injection Attack: **Introduction, Interacting with Web Application, Launching SQL Injection Attacks, Fundamental Causes, Countermeasures.**

UNIT V Security Mechanisms 9

Virtual Private Networks: How a VPN works, Building a VPN- Transport Layer Security (TLS/SSL)- Overview of TLS/SSL-TLS Handshake-TLS Data Transmission-TLS Programming(Client and Server side)- Firewalls- Types of firewalls-Net Filter- Building Firewall using NetFilter. **Anti-virus Software:** Importance of using Anti-virus, Need for Antivirus updation.

Total:45 G.

G. Learning Resources

i. Text Books :

1. {HYPERLINK "https://www.amazon.in/s/ref=rdr_kindle_ext_aut?_encoding=UTF8&index=books&field-author=James%20Cloud&search-alias=digital-text"},{HYPERLINK "https://www.amazon.in/dp/B00TWL8P3C/ref=rdr_kindle_ext_tmb" \o "Go to \ "Internet Security: Online Protection From Computer Hacking (Computer Security, Internet Hacker, Online Security, Privacy And Security)\ " page"}puter Hacking", Second Edition , Tata McGraw,2015. [Unit 1, 2]
2. Wenliang Du,"Computer & Internet Security: A Hands-on Approach", Tata McGraw Hill, Second Edition, 2019. [Unit 3,4,5]

ii. Reference:

1. Matthieu Bloch, Joao Barros, "Physical Layer Security from Information theory to Security Engineering", Cambridge University Press, First Edition, 2011.
2. Gupta, Sharma , "Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives", CRC Press, Second Edition, 2019.

iii. Online Resources:

1. Dinesh Thakur, 'Internet Architecture' , 2017. [Online], Available: {HYPERLINK "http://ecomputernotes"} .com/ computernetworkingnotes /services-and-applications/ internet-architecture [Accessed on 24.05.2019].
2. 'NetFilter' , 2014. [Online] Available: <https://www.netfilter.org/> [Accessed on 24.05.2019].

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS162	Blockchain Technology	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course covers the basic knowledge on private key cryptography and mining. It also covers technical aspects of bitcoin with cryptocurrencies, block chain technologies, consensus, hyperledgers, development tools and other transaction in networks to create new opportunity for innovation.

B. Prerequisite:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Interpret the basic concept of blockchain and its types, Consensus theorem , Decentralization	K2
C02	Recognize how cryptography techniques working in blockchain using RSA and other encryption standard.	K2
C03	Extend knowledge of Bitcoin techniques, Mining algorithm, PoW, PoS, PoD	K2
C04	Explain the concept of Smart Contracts, Ethereum with EVM and development tools.	K2
C05	Demonstrate knowledge of blockchain development tools and hyperledger concepts.	K3

K1- Remember, K2 – Understand, K3 – Apply, K4-Analyze, K5 –Evaluate, K6 –Create.

D. Correlation of COs with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	L	H						L		L					
CO2	H	L		L				M			L				
CO3	L	H	L					L		M					
CO4		H			H			L					M		L

CO5		H	L	M										L	L
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L – Low, M – Medium, H – High.

E. Course Content:

UNIT I Introduction to Blockchain

9

Blockchain: The growth of blockchain technology - Distributed systems - The history of blockchain and Bitcoin - Features of a blockchain - Types of blockchain, **Consensus:** Consensus mechanism - Types of consensus mechanisms - Consensus in blockchain. **Decentralization:** Decentralization using blockchain - Methods of decentralization - Routes to decentralization- Blockchain and full ecosystem decentralization - Smart contracts - Decentralized Organizations- Platforms for decentralization.

UNIT II Blockchain in Cryptography

9

Introduction - Working with the OpenSSL command line – Introduction: Mathematics, Cryptography, Confidentiality, Integrity, Authentication, Non-repudiation, Accountability - **Cryptographic primitives:** Symmetric cryptography, Data Encryption Standard, Advanced Encryption Standard - Public Key Cryptography - Asymmetric cryptography -Public and private keys - RSA - Encryption and decryption using RSA- Discrete logarithm problem in ECC - Encryption and decryption - ECC using OpenSSL - Hash functions -Message Digest- Merkle trees -Patricia trees - Financial markets and trading.

UNIT III Bitcoin

9

Introduction: Bitcoin - Private keys in Bitcoin, **Transactions:** The transaction life cycle - The transaction data structure - Types of transactions - Transaction malleability- Blockchain Mining, Tasks of the miners - Mining rewards Proof of Work (PoW) - The mining algorithm - The hash rate - Mining systems - Mining pools. **Bitcoin Network and Payments:** The Bitcoin network – Wallets - Bitcoin payments - Innovation in Bitcoin. **Bitcoin Clients and APIs:** Bitcoin installation. **Alternative Coins:** Alternatives to Proof of Work -Proof of Stake (PoS) - Proof of Deposit (PoD).

UNIT IV Smart Contracts & Ethereum

9

Smart Contracts: Introduction - Ricardian contracts - Deploying smart contracts on a blockchain. **Ethereum:** Introduction - The Ethereum network - Components of the Ethereum ecosystem - Transactions and messages - Ether cryptocurrency / tokens (ETC and ETH) - The Ethereum Virtual Machine (EVM), **Ethereum Development Environment:** Test networks - Setting up a private net - Starting up the private network.

UNIT V Blockchain Development Tools and Hyperledger Concepts

9

Development Tools and Frameworks: Compilers, Integrated Development Environments (IDEs), Tools and libraries, Contract development and deployment.

Solidity language: Types- Literals – Enums - Function types - Reference types - Global variables - Control structures. **Hyperledger:** Projects under Hyperledger - Hyperledger as a protocol - The reference architecture. Fabric: Hyperledger Fabric, Membership services, Blockchain services, Consensus services, Distributed ledger, **Corda:** Architecture - State objects – Transactions – Consensus- Flows and Components.

Total: 45

F. Learning Resources

ii. Text Book

1. Imran Bashir, "Mastering Blockchain: Distributed ledger technology, decentralization, and smart contracts explained", Birmingham – Mumbai: Packt, 2nd Edition Kindle, 2018.
[Unit 1 to 5]

ii. Reference Book

1. Narayanan A, Bonneau J, Felten E, Miller A, and Goldfeder S, "Bitcoin and Cryptocurrency Technologies – A Comprehensive Introduction", Princeton University Press, 2016.

iii. Online References

1. Anders Brownworth, "Anders Brownworth Technology and Disruption", January 2019. [Online]. Available: {HYPERLINK "https://anders.com/blockchain/blockchain.html"}. [Accessed May 24, 2019].
2. Juan Navarro, Biztribution, "Get Started with Hyperledger Fabric", April 24, 2019{HYPERLINK "https://www.hyperledger.org/category/blog"}. [Online]. Available: {HYPERLINK "https://www.hyperledger.org/projects/fabric"}. [Accessed May 24, 2019].
3. Bob Dill, David Smits, "Zero to Blockchain - An IBM Redbooks course", November 2017. [Online]. Available: {HYPERLINK "https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html"}. [Accessed May 24, 2019].

- Praveen Jayachandran, "NPTEL", June 2018. [Online]. Available: {HYPERLINK "https://nptel.ac.in/courses/106105184/"}. [Accessed May 24, 2019].

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS177	Cloud Security	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course covers the basic concepts cloud security in infrastructure, data and systems, which are widely used in the design of cloud security. The issues related multi tenancy operation, virtualized infrastructure security and methods to improve virtualization security are also dealt with in this course.

B. Prerequisite:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos	course outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Summarize the basic concept of cloud computing.	K2
C02	Interpret the infrastructure security and data security in cloud	K2
C03	Explain the concepts of security management, identity and access management in cloud security.	K2
C04	Outline about privacy, audit and compliance in cloud security.	K2
C05	Discuss the security-as-a-[cloud] service and Hypervisor Risks-VM.	K2

K1 – Remember, K2 – Understand, K3 – Apply, K4 – Analysis, K5 – Evaluate, K6 - Create

D. Correlation of COs with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M		L			L									
CO2		L	M			L								L	
CO3		L	M			L	L				L				L
CO4					L	H		L			L				
CO5	L				M	L	L				L			L	

E. Course Content:**UNIT I Cloud Computing Fundamentals**

9

Cloud Computing: SPI Framework for Cloud Computing - Traditional Software Model - Cloud Services Delivery Model - Cloud Deployment Models - Key Drivers to Adopting the Cloud- Impact of Cloud Computing on Users - Governance in the Cloud.

UNIT II Infrastructure Security and Data Security

9

Infrastructure Security: The Network Level: Ensuring Data Confidentiality and Integrity - Ensuring Proper Access Control- Network-Level Mitigation: SaaS and PaaS

{PAGE }

Host Security. **Host Level:** Virtualization Software Security- Threats to the hypervisor - Virtual Server Security **Infrastructure Security:** The Application Level- DoS and EDoS - End User Security. **Data Security and Storage:** Aspects of Data Security - Data Security Mitigation - Provider Data and Its Security- Storage- Confidentiality- Integrity- Availability.

UNIT III Security, Identity and Access Management in Cloud

9

Security Management Standards-Security Management in the Cloud- **Availability Management:** SaaS, PaaS, IaaS -Access Control- Security Vulnerability, Patch and Configuration Management. **IAM Challenges** -IAM Definitions - IAM Architecture and Practice - Relevant IAM Standards and Protocols for Cloud Services- IAM Practices in the Cloud - Cloud Authorization management

UNIT IV Privacy, Audit and Compliance

9

Privacy: Data Life Cycle-Key Privacy Concerns- Responsible for Protecting Privacy- Changes to Privacy Risk Management and Compliance -Legal and Regulatory Implication-U.S. Laws and Regulations - International Laws and Regulations. **Audit and compliance:** Internal Policy Compliance -Governance, Risk, and Compliance - Control Objectives for Cloud Computing -Incremental CSP-Specific Control Objectives - Additional Key Management Control Objectives - Control Considerations for CSP Users - Regulatory/External Compliance -Cloud Security Alliance -Auditing the Cloud for Compliance

UNIT V Security-As-A-[Cloud] Service.

9

Security-as-a-[cloud] service: Origins -Email Filtering - Web Content Filtering - Vulnerability Management- Identity Management-As-a-Service-Impact of cloud computing in corporate- Security policy implementation and Types- Hypervisor Risks- VM Security Recommendations. **Examples** of Cloud Service Providers related with security.

Total: 45

F. Learning Resources

i. Text Books

1. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance" O'Reilly Media; 1 edition

[ISBN: 0596802765], 2009.

ii. Reference Books

1. Ronald L. Krutz, Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, 2010,

iii. Online References

1. Bob Dill, David Smits. (2017, Nov.) [Online]. Available: {HYPERLINK "https://www.ibm.com/in-en/cloud/security"} [Accessed on 25.5.19]
2. {HYPERLINK "http://www.iitkgp.ac.in/department/CS/faculty/cs-skg" \t _blank}, Week 6 (2018, June) NPTEL [Online]. Available: {HYPERLINK "https://nptel.ac.in/courses/106105184/"} [Accessed on 25.5.19]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS179	Security in IoT	3	0	0	3

Course Category: Program Elective

A. Preamble :

This course gives an overview of IoT system in security aspects. The course mainly focuses on current security risks IoT domain faces and countermeasure available for the known issues.

B. Prerequisite Course:

S.No	Course Code	Course Name
1	1152CS209	Internet of Things

C. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the basics of IoT Security	K2
CO2	Recognize IoT security and vulnerability threats.	K2
CO3	Design and development of Security services	K2
CO4	Understand the cryptographic fundamentals of IoT	K2
CO5	Know the identity and access management of IoT	K2

K1-Remember; K2-Understand; K3- Apply; K4-Analyze; K5 – Evaluate; K6 Create.

D. Correlation of COs with POs :

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L		L		L	L				L		L		
CO2	M	H			L								L		L
CO3	M	L	M					L				L	L	M	L
CO4	H	M			L			L					H		L
CO5	H	M		L				L					M		L

H- High; M-Medium; L-Low

E. Course Content :

UNIT I: Introduction to IoT Security	9
---------------------------------------------	----------

Security a Major Concern: Confidentiality, Authentication, Data Integrity, Cyber Threats and Detection, Threat Mitigation, Malware Resistance; **Business Aspects in IoT, Industrial IoT (IIoT):** Security Requirements in IIoT, **Vehicular Sensor Network:** Sensors in VANET, Security in VANET, IoT Enabled Wearable Devices, **IoT in Smart Homes/Cities, Green IoT, Video Streaming and Data Security from Cameras, IoT Security Activities:** Device Manipulation, Risk Management.

UNIT II IoT Vulnerabilities, Attacks, and Countermeasures

9

Primer on threats, vulnerability, and risks (TVR): The classic pillars of information assurance, Threats, Vulnerability and Risks. **Primer on attacks and countermeasures:** Common IoT attack types, Attack trees, Fault trees and CPS, **Today's IoT attacks:** Attacks Wireless reconnaissance and mapping, Security protocol attacks, Physical security attacks and Application security attacks, **Threat modeling an IoT system.**

UNIT III Security Engineering and Life Cycle	9
-----------------------------------------------------	----------

Security Engineering: Building security in to design and development, Secure design, Safety and security design, Processes and agreements, Technology selection – security products and services. **The secure IoT system implementation lifecycle:** Implementation and integration, Operations and maintenance.

UNIT IV Cryptographic Fundamentals for IoT

9

Cryptography and its role in securing the IoT: Types, Encryption and Decryption, Hashes and Digital Signature, **Cryptographic module principles, Cryptographic key management fundamentals:** Key generation, Key establishment, Key derivation, Key storage, Key escrow, Key lifetime, Key zeroization, Accounting and management, **Examining cryptographic controls for IoT protocols:** Cryptographic controls built into IoT communication protocols and messaging protocols.

UNIT V Identity and Access Management for IoT	9
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The identity lifecycle: Establish naming conventions and uniqueness requirements, Secure bootstrap, Credential and attribute provisioning, Account monitoring and control, Account updates, Account suspension and Account/credential deactivation/deletion **Authentication credentials:** Passwords, Symmetric keys, Certificates, Biometrics and New work in authorization for the IoT. **IoT IAM infrastructure:** 802.1x, PKI for the IoT. Authorization and access control.

Total: 45

F. Learning Resources

i. Text Books

1. Shishir K. Shandilya , Soon Ae Chun, , Smita Shandilya, , Edgar Weippl, "Internet of Things Security: Fundamentals, Techniques and Applications", River Publishers, ISBN: 9788793609532 , 2018. [Unit 1]
2. Russell, Brian and Drew Van Duren, "Practical Internet of Things Security", 1st Edition, Packt Publication, 2016. [Unit 2-5]

ii. Reference Books

1. Shishir K. Shandilya , Soon Ae Chun, , Smita Shandilya, , Edgar Weippl, "Internet of Things Security: Fundamentals, Techniques and Applications", River Publishers, ISBN: 9788793609532 , 2018.
2. Fei HU, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, 2016.

iii. Online References

1. T V Prabhakar, "BLE Security", in Design for Internet of Things, Module: 7 Lecture: 27., 2017 .[Online] , Available : {HYPERLINK "https://nptel.ac.in/courses/108108098/27"} [Accessed: 23- May-2019]
2. Shachar Siboni ; Vinay Sachidananda ; Yair Meidan ; Michael Bohadana ; Yael Mathov ; Suhas Bhairav ; Asaf Shabtai ; Yuval Elovici, "Security Testbed for Internet-of-Things Devices", Volume: 68 , Issue: 1, 2019 [Online], Available: {HYPERLINK "https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=8565917"} [Accessed: 23- March-2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS176	Cyber Laws and Security Issues	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course covers the basic knowledge of cyber laws for National and International Perspective and also it covers aspects of security issues, Cyber Crimes, Legal Perspectives

B. Prerequisite:

Sl. No	Course Code	Course Name
1	1152CS158	Cyber Security

C. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
C01	Understand the basic knowledge of cyber laws and its related laws for national and Global Act	K2
C02	Analyse the nature and scope of cybercrime	K2
C03	Discuss security policies in cyber laws	K2
C04	Explain cyber security issues using privacy policies	K2
C05	Interpret key terms and concepts of intellectual property, trademarks and domain theft.	K2

K1-Remember; K2-Understand; K3- Apply; K4-Analyze; K5 – Evaluate; K6 Create.

D. Correlation of COs with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PS O 1	PSO 2	PSO 3
CO1	M					M		H				L	L		
CO2		M		M				H				L		M	
CO3		M							M	H					M
CO4	M						M		M						H
CO5			M					H	M		M				H

H- High; M-Medium; L-Low

E. Course Content:

UNIT-I: Introduction to Cyber Laws

9

Cyber Laws: Introduction to Cyber Law -Definition- History of Cyber laws – An Overview of Cyber law in India - Need of Improvement in Indian Cyber Law - International perspective on Cyber Laws.

UNIT-II: Cyber Crimes and Cyber Security-Legal Perspectives

9

Cyber Crime: An History of Cyber crime - Meaning of Cyber crimes- Cyber Privacy, Cyber Security -Information Technology Act, 2000 - **Classifications of cyber crime** - Kinds of cyber crime - International legal Perspective of cyber crime.

UNIT –III: Security Policies in Cyber Laws

9

Introduction to IT Act: Scope and Application- Need for An Information Security Policy-Information Security Standards - Introducing Various Security Policies and Their Review Process -Objective and Scope of the it Acts.

UNIT –IV: Security Issues and Measures

9

Security Issues: Backup Security Measures - Secure Information System Development-Application Development Security-Information Security Governance and Risk Management

Measures: Security Architecture and Design-Security Issues in Hardware, Data Storage and Downloadable Devices-Physical Security of it Assets

UNIT -V: Overview of Intellectual Property

9

Overview of Intellectual : Intellectual Property Issues - Property - Related Legislation in India- Patent –Copyright - Law Related to Semiconductor Layout and Design Software License

Total: 45

F. Learning Resource

i. Text Book:

1. Om Prakash Gusai , “Concept Building Approach to Cybercrimes and Cyber Laws : Indian and International Perspective”, Cengage publication, 2019. [Unit 1 & 2]
2. Tripathi Surya Prakash, “Introduction to Information Security and Cyber Laws” , Dream tech Press India Pvt. Ltd, 2014. [Unit 3,4 & 5]

ii. References Book:

1. Prashant Mali, “Cyber Law & Cyber Crimes Simplified,” Cyber Infomedia, 6th edition, 2015.
2. Nina Gobole and Sunit Belapure, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives,” Wiley India, 2012.

iii. Online resources:

1. Indian Law Institute, New Delhi , “Cyber Laws”, [Online]. Available :
<http://www.ili.ac.in/e-learnCL.htm>, [Accessed: 23-May-2019]
2. Rohan Nagal, 2014, Available: {HYPERLINK
"<http://osou.ac.in/eresources/introduction-to-indian-cyber-law.pdf>"}, [Accessed:
23-May-2019]
3. Government of India, Available: {HYPERLINK "https://digitalindia.gov.in"},
[Accessed: 23-May-2019]
4. India's first Forensic Organization providing Forensic Education, 2018,
Available: <http://ifs.edu.in/cyber.law.html> [Accessed : 24-May-2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS226	SYSTEM AND NETWORK SECURITY	3	0	2	4

Course Category: Program Elective

A. Preamble:

This course provides information about the basic concepts and techniques of system and network security and also describes the recent advancement in computer systems and provides the knowledge in email, web and mobile security.

B. Pre-requisite:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and network security
2	1152CS117	Information Security

D. Course Outcomes:

Upon the successful completion of the course, students will be able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the basics of security trends	K2
CO2	Explain the concepts of physical security monitoring.	K2
CO3	Identify the security issues and mechanism in networks.	K2
CO4	Outline the Email and Web Security Components.	K2
CO5	Apply the techniques of wireless networking in mobile devices.	K3

K1-Remember K2-Understand K3-Apply

E. Correlation of COs with Program Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L					L						L		
CO2	M		M				H								
CO3	M	M			M	M								M	
CO4	M	M				L		L							

CO5	M	L		L		L		M			H	
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H- High; M-Medium; L-Low

F.Course Content:

UNIT I INTRODUCTION AND SECURITY TRENDS

9

Introduction-Historical Security Incidents-Threats to Security-Viruses and Worms-Intruders-insiders-Attributes of Actor-Internal/External-Level of sophistication-Security Trends-**Targets and Attacks**-Specific target-Opportunistic target-Minimum possible avenues of Attack-Approaches to Computer Security-Cyber attack Kill Chain, Thread Intelligence, Open Source Intelligence -Security Principles and Security Models - Confidentiality and Integrity Models.

UNIT II PHYSICAL SECURITY

9

Physical Security Introduction-Safeguards-Walls and Guards-Physical Access Controls and Monitoring-Electronic Access Control Systems-Policies and Procedures-Environmental controls-**Fire Suppression**-Water based Fire Suppression System, Halon-based Fire Suppression System, Fire detection devices - Electromagnetic Environment-Power Protection-USB-Backup Power Cable Shielding.

UNIT III NETWORK SECURITY

9

Network based IDSs:Advantages of an NIDS-Disadvantages of an NIDS-Active vs Passive NIDS,NIDS Tools-Host based IDSs-Intrusion Prevention systems-Network Security Monitoring- **Network Hardening** –Application Hardening-Data based security controls-SIEM-Aggregation-correlation, Automated Altering and triggering Time Synchronization,-Event deduplication-Log/Worm-DLP-USB Blocking-Cloud based DLP.

UNIT IV EMAIL AND WEB COMPONENTS

9

How E-mail Works: E-mail Structure, MIME-Security of Email: Spam, Malicious Code-Hoax

E-Mail- Mail Gateway-Spam Filter Mail Relaying-Greylisting-Mail Encryption- Spam URI Real Time Block List, **SPF-Web components** and its Protocol-Code Based Vulnerabilities-Application based Weakness: Session Hijacking-Client Side Attack-Web 2.0 and Security.

UNIT V WIRELESS SECURITY AND MOBILE DEVICE

9

Introduction to wireless networking-Mobile Phones-Wireless Application protocol-3G Mobile Networks-4G Mobile Networks-SATCOM-Bluetooth attack-Near field Communication-Wireless System Configuration-**Wireless Attacks**-Reply-Evil Twin-Rogue AP Jamming Blue jacking-Mobile Device Management Concepts-Application

Management, Content Management -Mobile Application security: Application Control-Key and Credential Management, Authentication-Encryption-Application White listing.

G. Lab Experiments: 15

1. Eavesdropping Attacks and its prevention using SSH.
2. Perform An Experiment To Demonstrate How To Sniff For Router Traffic By Using The Tool Wireshark.
3. Study of the features of firewall in providing network security and to set Firewall Security in windows.
4. Demonstrate intrusion detection system (ids) using any tool (snort or any other s/w).
5. Setup a honey pot and monitor the honeypot on network (KF Sensor)
6. Installation of rootkits and study about the variety of options.
7. Perform wireless audit on an access point or a router and decrypt WEP and WPA. (Net Stumbler)
8. Study of different wireless network components and features of any one of the Mobile Security Apps.

Total : 75

H. Learning Resources

i. Text Book

[1].WM. Arthur Conklin, Greg White, 'Principles of Computer Security', McGraw-Hill Education, fifth edition, 2018.[UNIT 1,2,3,4,5]

ii. Reference Book:

[1].Wolfgang Osterhage, , 'Wireless Network Security', CRC Press, Taylor and Francis Group, second edition, 2018.

[2].{HYPERLINK

"https://www.amazon.com/s/ref=rdr_ext_aut?_encoding=UTF8&index=books&field-author=David%20Kim"}{HYPERLINK

"https://www.amazon.com/s/ref=rdr_ext_aut?_encoding=UTF8&index=books&field-author=Michael%20G.%20Solomon"}, 'Fundamentals of Information Systems Security', Jones &

Bartlett Learning, third edition, 2016.

iii. Online Resource:

[1]. Sandeep Shukla, 'Computer Systems Security'. [Online]. Available:{HYPERLINK "<http://www.cse.iitk.ac.in/users/sandeeps/>"}. [Accessed: 24-May- 2019].

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS141	Cyber Physical Systems	3	0	0	3

Course Category: Program Elective

A. Preamble :

{PAGE }

This course describes the concepts of network security and cyber physical systems.

B. Prerequisite Course:

S.No	Course Code	Course Name
1	1151CS111	Computer Network

C. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the working principles of CPS	K2
CO2	Apply the software components and scheduling in cps	K3
CO3	Explain the concepts Dynamic systems	K2
CO4	Know the safety components in CPS	K2
CO5	Design and Development of case studies in CPS	K3

K1-Remember; K2-Understand; K3- Apply; K4-Analyze; K5 – Evaluate; K6 Create.

D. Correlation of COs with POs :

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	L			L							L	H	L	
CO2	H	L			L								H	M	
CO3	H	M			L								H		
CO4	H	H		H									H		
CO5	H	H				H	H	H					H		L

H- High; M-Medium; L-Low

E. Course Content :

UNIT 1 Introduction to Cyber-Physical Systems

9

Cyber-Physical Systems (CPS) in the real world, Basic principles of design and validation of CPS, Industry 4.0, CPS CHARACTERISTICS, MARKET ANALYSIS of CPS, Role of CPS in different Domains, Finite-State Components, Combinational Components, Event Triggered Components, Nondeterministic Components, Input-Enabled Components.

UNIT II Software Components in CPS	9
Real-Time Scheduling - Scheduling Concepts, EDF Scheduling, Fixed-Priority Scheduling, Asynchronous Coordination Protocols- Leader Election, Reliable Transmission, Wait-Free Consensus.	

UNIT III Safety and CPS	9
Formal Methods for Safety Assurance of Cyber-Physical Systems Basic introduction and examples Timed and Hybrid Automata Formal Analysis: Flow pipe construction, reachability analysis of CPS Software Weakest Pre-conditions	

UNIT IV Security in CPS	9
CPS SW Verification: Secure Deployment of CPS Attack models Secure Task mapping and Partitioning State estimation for attack detection Automotive	

UNIT V CPS Case Studies	9
Automotive: SW controllers for ABS, ACC, Lane Departure Warning, Suspension Control	
Healthcare: Artificial Pancreas/Infusion Pump/Pacemaker Green	

TOTAL: 45

i. TEXT BOOK

1. Rajeev Alur, “{HYPERLINK “https://mitpress.mit.edu/books/principles-cyber-physical-systems” \t “_blank”}”, MIT Press, 2015.[Unit 1-5]

ii. REFERENCE BOOK

1. Houbing Song, Danda B Rawat, Sabina Jeschke, Christian Brecher, “Cyber-Physical Systems: Foundations, Principles and Applications”, Academic Press, 2016.
2. Danda B. Rawat, Joel J.P.C. Rodrigues, Ivan Stojmenovic, “Cyber-Physical Systems: From Theory to Practice”, CRC Press, 2015.

iii. ONLINE REFERENCE

1. Keke Gai ; Meikang Qiu, Hui Zhao, Xiaotong Sun, “Resource Management in Sustainable Cyber-Physical Systems Using Heterogeneous Cloud Computing”, Volume 3 issue : 2 , IEEE Transactions on Sustainable Computing, [Online],

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- Available: {HYPERLINK "https://ieeexplore.ieee.org/document/7970164"} [Accessed: 23- March-2019]
2. Andre Platzer, "Lecture Notes on Foundations of Cyber-Physical Systems", Carnegie Mellon University. [Online], Available: {HYPERLINK "http://www.cs.cmu.edu/~aplatzer/course/fcps14/fcps14.pdf"} [Accessed: 23-March-2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS225	Sentiment Analysis	3	0	2	4

Course Category: Program Elective

A. Preamble:

The Sentiment analysis course provides an overview on the need for sentiment analysis, explore the various methodologies necessary to perform sentiment classification, opinion summarization and various tools used for sentiment analysis.

B. Pre-requisites:

S1 No	Course Code	Course Name
1	1152CS140	Machine Learning Techniques

C. Related Courses:

S1 No	Course Code	Course Name
1	1152CS207	Machine Learning using R

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the various algorithms to perform opinion	K2

	mining, subjectivity and emotion	
CO2	Identify the sentiment of any document, web-page or social networking site	K3
CO3	Recognize aspect based opinion summary and entity extraction	K2
CO4	Underline the opinion summarization using various approaches	K2
CO5	Use the apt tools to perform sentiment analysis for any given application	K3

K1-Remember; K2-Understand; K3- Apply; K4-Analyze; K5 – Evaluate; K6 Create.

E. Correlation of COs with POs :

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	
CO1	H	M	H	M					L				H	M	M	L
CO2	H	H	H	H					M				M	H	M	L
CO3	M	L	M	M					M				M	H	M	M
CO4	H	M	M	L		L			L				M	L	H	H
CO5	H	H	H	H	H	L			H				H	L	H	H

H-High; M-Medium; L-Low

F. Course content:

UNIT I Introduction

9

Need for Sentiment Analysis – Problem of Sentiment Analysis - Subjectivity – Stance – Words to Discourse – Pragmatics – Natural Language Processing Issues – Opinion Definition – Sentiment Analysis Tasks – Opinion Summarization – Types of Opinion – Subjectivity and Emotion

UNIT II Document Sentiment Classification

9

Sentiment Classification Using Supervised Learning – Unsupervised Learning – Rating Prediction – Cross-Domain Sentiment Classification – Cross-Language Sentiment Classification – Sentence Subjectivity And Classification – Subjectivity Classification – Sentence Sentiment Classification – Conditional Sentences - Sarcastic Sentences – Cross-Language Subjectivity and Sentiment Classification – Discourse Information for Sentiment Classification

UNIT III Aspect Based Sentiment Analysis

9

Aspect sentiment classification – Basic rules of opinions and Compositional Semantics – Aspect Extraction – Identifying Resource usage aspect – Simultaneous Opinion Lexicon Expansion and Aspect Extraction – Grouping aspects into categories – Entity, Opinion Hold and Timing Extraction – Coreference Resolution and Word Sense Disambiguation – Aspect and Entity Extraction – Sentiment Lexicon Generation – Corpus Based Approach – Dictionary Based Approach – Desirable and Undesirable Facts

UNIT IV Opinion Summarization

9

Aspect Based Opinion Summarization – Improvements to Aspect-Based Opinion Summarization – Contrastive view Summarization – Traditional Summarization – Analysis of Comparative Opinions –Identifying Comparative Sentences – Identifying Preferred Entities – Opinion Search and Retrieval –Opinion Spam Detection – Types of Spam Detection - Supervised and Un-Supervised Approach –Group Spam Detection

UNIT V Tools for Sentiment Analysis

9

Detecting Fake or Deceptive Opinions - Quality of Review – Quality as Regression Model – Other Methods – Case Study – Sentiment Analysis Applications – Tools for Sentiment Analysis – Semantria – Meltwater – Google Analytics – Face Book Insights – Tweetstats.

List of Experiments: **15**

1. Specifying text content
2. Sentiment analysis, Syntactic analysis- Sentence extraction, Tokenization
3. Entity analysis, Entity sentiment analysis
4. Text Emotion Analysis
5. Prediction of subjective user opinion
6. Binary Classification: Twitter sentiment analysis

7. Prediction of subjective user opinion
8. Spam Detection
9. Group Sam Detection
10. Case Study on Tolls such as Clarabridge, Sentigem, OpenText and Lexalytics.

Total: 75

G. Learning Resources

i. Text Book

1. Bing Liu, Sentiment Analysis and Opinion Mining: Morgan and Claypool publishers, 2012. (Unit 1-5)

ii. Reference books

1. Bo Pang and Lillian Lee, Opinion Mining and Sentiment Analysis: Now Publishers Inc, 2008.
2. Roy De Groot, Data mining for Tweet sentiment classification – Twitter sentiment Analysis: LAP Lambert Academic Publishing, 2012.

iii. Online Resources

1. {HYPERLINK "https://nptel.ac.in/courses/106105158/61"}
2. {HYPERLINK "https://web.stanford.edu/class/cs124/lec/sentiment.pdf"}
3. {HYPERLINK "https://www.cs.uic.edu/~liub/FBS/SentimentAnalysis-and-OpinionMining.pdf"} (Text Book)
4. {HYPERLINK "https://cloud.google.com/natural-language/docs/basics"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS311	Competitive Coding – I	0	0	2	1

A. Preamble

Solving the problems under the “easy difficulty” category in online coding platforms like hacker rank, hacker earth, codechef, etc. The Students were expected to prepare themselves on the tasks which in turn help them to achieve logic building skills.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Course Outcomes

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Analyze feasibility of programming solution for the real world's problem.	K4
CO2	Identify the complexity of taken problem.	K3
CO3	Identify the suitable programming language to implement the solution for the taken problem.	K3
CO4	Apply logic building skills over the taken problem.	K3
CO5	Choose the best solution from the availability.	K5

K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6>Create

D. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	L	L		L					M				M	L	L	L
CO2	L	L		L					M				M	L	L	L
CO3		L	L						L				L		L	L
CO4	L		H		L			M	H				M	L	M	M
CO5	L	L	M		L	L	L	L	M				M	L	M	M

H- High; M-Medium; L-Low

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS312	Competitive Coding – II	0	0	2	1

A. Preamble

Solving the problems under the “medium difficulty” category in online coding platforms like hacker rank, hacker earth, codechef, etc. The Students were expected to prepare themselves on the tasks which in turn help them to achieve logic building skills.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Course Outcomes

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Analyze feasibility of programming solution for the real world's problem.	K4
CO2	Identify the complexity of taken problem.	K3
CO3	Identify the suitable programming language to implement the solution for the taken problem.	K3
CO4	Apply logic building skills over the taken problem.	K3

CO5	Choose the best solution from the availability.	K5
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K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6>Create

D. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	L	M		M					M				M	M	L	L
CO2	M	M		M					M				M	M	L	M
CO3		L	L						L				L		L	L
CO4	L		H		L			M	H				M	L	M	M
CO5	M	M	M		L	L	L	L	M				M	M	M	M

H- High; M-Medium; L-Low

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS313	Competitive Coding – III	0	0	2	1

A. Preamble

Solving the problems under the “higher difficulty” category in online coding platforms like hacker rank, hacker earth, codechef, etc. The Students were expected to prepare themselves on the tasks which in turn help them to achieve logic building skills.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Course Outcomes

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on
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		revised Bloom's taxonomy)
CO1	Analyze feasibility of programming solution for the real world's problem.	K4
CO2	Identify the complexity of taken problem.	K3
CO3	Identify the suitable programming language to implement the solution for the taken problem.	K3
CO4	Apply logic building skills over the taken problem.	K3
CO5	Create the best solution for the taken problem with respect to time and space complexity.	K6

K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6-Create

D. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	M	H		H			L		M				M	M	L	H
CO2	H	M		M					M				M	H	L	M
CO3		L	M						L				L		L	L
CO4	M		H		L			M	H				M	M	M	M
CO5	H	H	H		L	M	M	L	M				M	H	M	H

H- High; M-Medium; L-Low

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS318	Competitive Programming – II	0	0	2	1

A. Preamble

The course focuses in the development and implementation of algorithms, as well as the skills required for problem solving. Students will learn to select appropriate algorithms for a given well known computer science problem, find a solution to solve them as fast as possible, integrate multiple algorithms for solving a complex problem. Students will also learn skills required for participation in programming contests. The possible long

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term effect is to bring students as future computer science researchers who are well versed in problem solving skills.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Course Outcomes

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Assess the time and memory complexity of an algorithm or a structure	K5
CO2	Demonstrate the basics of programming and mathematical fundamentals	K4
CO3	Create good and correct algorithm for problem solving related to arrays , string, bitmap.	K6
CO4	Demonstrate both iterative and recursive techniques for solving wider problems on stack, queue and linked list	K4
CO5	Apply sorting and searching algorithm techniques and methods to solve complex problems.	K3

K1-Remember K2-Understand K3-Apply K4-Analyze K5-Evaluate K6>Create

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M			H		M							M		
CO2	H	M	H				M		H				H	M	H
CO3	H	H		H									H	H	
CO4	M	H	H				H						M	H	H
CO5	H	H	M	M		M			M				H	H	M

H- High; M-Medium; L-Low

COURSE CODE	COURSE TITLE	L	T	P	C

1152CS319	Competitive Programming – III	0	0	2	1
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A. Preamble

This course is recommended for students hoping to learn how to solve difficult problems that appear in multi-stage programming contests. The students will learn to design time and space efficient algorithms to solve challenging contest problems, and produce bug-free code under the pressure of time in contest. Students will learn to handle corner cases, invalid inputs, recursion conditions, memory leaks and test cases effectively. The true end goal is to produce all-round computer scientists/ programmers who are much readier to produce better software and to face harder CS research problems in the future.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Course Outcomes

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Apply advanced Array, String and mathematical algorithms for problem solving	K3
CO2	Demonstrate stack, queue and sorting algorithms to data structures to solve problems.	K6
CO3	Implement classical algorithms for trees and graphs with backtracking concepts, being aware of their trade-offs in terms of complexity in time/space	K5
CO4	Analyze and implement efficient algorithms for challenging computational problems on advanced data structures, in practice, quickly and correctly.	K4
CO5	Solve complex problems using dynamic programming and greedy algorithm.	K6

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M											H	M	
CO2	H	H		H									H	H	
CO3	H	H	H	M		H	H						H	H	H
CO4	M	M	M	H			M					H	M	M	M
CO5	H	H	H	H			M					H	H	H	H

H- High; M-Medium; L-Low

F. Course Description

This course introduces advanced algorithms and data structures concepts useful for competing effectively in programming contests. This course provides familiarity with and proficiency in solving intermediate-difficulty algorithmic programming problems using dynamic programming, graph algorithms, mathematics, computational geometry, combinatorial games, and standard library data structures. It includes connectivity-based dynamic programming, multi-dimensional computational geometry, advanced string algorithms, advanced data structures, advanced graph and tree algorithms, linear programming, and satisfiability.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS180	Introduction To Fintech	3	0	0	3

A. Preamble

Financial technology, commonly called “FinTech”, is now a highly used buzzword. The financial services industry, once considered most resistant to disruption, is undergoing a continuous transformation brought in by the never ending stream of digital disruptions. Bitcoin has captured public imagination, and mobile payment apps have become ubiquitous in a short span of less than a year. FinTech is an evolving segment of the financial services sector where tech-focused startups and other new market entrants are disrupting how the financial services industry traditionally operates by using machine learning, big data, cloud computing, and cryptographic methods to stay ahead of changing business trends. This interdisciplinary course will enable you to understand the landscape of financial services industry, the role of finance function in making payments, investments, managing personal finances across life cycle and a market place for transferring risk, along with understanding “regulation”. This would be coupled with learning about the technology that is impacting the related financial services and its delivery.

B. Pre-Requisite

Finance or Technology background

C. Link to Other Courses

To courses in areas of Finance and Technology

D. Course Educational Objectives

1. To create a fundamental understanding of the role played by FinTech across finance functions and services
2. To know about the technology that is enabling FinTech

E. Course Outcomes

Upon successful completion of this module, the students will be able to:

CO Nos	Course Outcomes	Level of Learning domain (Based on Revised Bloom's)
CO1	Understand the background of Financial Services Industry	K1
CO2	Know about banking operations	K2
CO3	Have an idea of FinTech and its evolution	K2
CO4	Understand the interaction of finance and technology across the financial system	K2
CO5	An insight into the major technologies involved and the emerging business models and players in the industry	K1

F. Course Contents

Batch Launch: Introduction to the course and area – Program Curriculum - Learning Methodology

Unit I: Introduction to FinTech 5

Innovation and technology – The Indian FinTech Landscape: Digital India and its role in promoting FinTech - What is FinTech? - Why the Hype? - Market Size and Potential – FinTech Hubs - The History of Fintech **Case Study: The Aadhar Effect**

Unit II: Financial Markets Overview 13

Role of Finance - Indian securities market: Equity Market – Debt Market – FX: Forex market - Derivatives - Futures and Options – Types of instruments: Ownership securities – Bonds – Convertibles – Warrants – New age arrangements: Futures – Options – Swaps - Forwards

Unit III: Banking Landscape 9

Overview of Retail Banking: Banking Operations – Banking Products: Deposit products – Loan products - Other banking services: Insurance and Mutual Funds & Asset management - Management - Key Players - Emerging Trends: Digital banking – Small Finance banks

Unit IV: FinTech: Breaking the Financial services Value Chain

9

Overview of FinTech - Disruptions in the area of Payments, Wealth Management, Investments, Lending - Reg Tech and Insurance Tech - Understanding UPI – Unified Payments Interface and its implications – Integrated Digital banking – Financial Inclusion and role of FinTech in Financial Inclusion

Case Study: Growth of FinTech in India: Kotak FinTech Mobility (as a part of Make in India Initiative)

Unit V: FinTech Analytics

9

Artificial intelligence and Machine Learning applications in Accounts and Finance - Understanding the technology enabling Fintech - and what constitutes a Fintech application -

Data Analytics in Financial Services - Crypto-currencies and Blockchain – Understanding of Blockchain technology, its potential and application – overview of crypto currency.

Total: 45

G. Learning Resources:

i. Text Books

1. Jacob William, FinTech: The Beginner's Guide to Financial Technology, 2016
2. IIBF, Digital Banking, Taxmann Publication, 2016.

ii. Reference Books

1. Jacob William, Financial Technology, Createspace Independent Pub, 2016
2. Luke Sutton, Financial Technology: Bitcoin & Blockchain, Createspace Independent Pub, 2016

iii. Online Learning:

Following links can serve as online resources for students:

1. {HYPERLINK "http://www.rbi.org.in"}
2. {HYPERLINK "http://www.ibf.org"}
3. {HYPERLINK "https://bankinnovation.net/"}
4. {HYPERLINK "http://www.mobilepaymentstoday.com"}
5. {HYPERLINK "http://www.fiovote.com"}
6. {HYPERLINK "http://www.finextra.com"}

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COURSE CODE	COURSE TITLE	L	T	P	C
1152CS229	BIG DATA ARCHITECTURE AND TOOLS	2	0	2	3

Course Category: Program Elective

G. Preamble:

This course covers foundational techniques and tools required for data science and big data analytics. The course focuses on concepts, principles, and techniques applicable to any technology environment and industry and establishes a baseline that can be enhanced by further formal training and additional real-world experience.

H.Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS107	Data Base Management Systems

I. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS139	Data Science
2	1151CS117	Data Mining and Data Warehousing

J. Course Educational Objectives:

Learners are exposed to

- To explore the fundamental concepts of big data analytics.
- To learn to analyze the big data using intelligent techniques.
- To understand the various search methods and visualization techniques.
- To learn to use various techniques for mining data stream.

K. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Differentiate traditional data processing with Big Data Analytics.	K2 , S3
CO2	Explain the technology landscape behind the Big Data Analytics using Hadoop and HIVE	K3 , S3
CO3	Solve distributed computing challenges with the help of MongoDB.	K3 , S3
CO4	Perform data analysis using R and Octoparse	K3 , S3
CO5	Perform essential operations for data sharing using Spark RDD	K3 , S3

L. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M														
CO2	L	L	M		H										
CO3	L				H										
CO4	L				H										
CO5	L				H									H	

H- High; M-Medium; L-Low

M. Course Content:

UNIT I – INTRODUCTION TO BIG DATA

6

Introduction –Classification of Digital Data- Distributed file system – Big Data and its importance - Four V's - Big data applications - Traditional Business Intelligence (BI) versus Big Data - Challenges of Big Data.

UNIT II – BIG DATA USING HADOOP & HIVE

6

Hadoop: Understanding the Map Reduce architecture - Algorithms using map reduce - Hadoop MapReduce Programs - Executing the Map phase - Shuffling and sorting - Hadoop Eco System – Data in and out of Hadoop – Hadoop Storage: HDFS, Common Hadoop Shell commands – CAP Theorem – BASE.

Introduction to Hive: Architecture - Hive Data Types: Hive Query Language, Starting Hive Shell, Partitions, Buckets, SERDE, UDF – CAP theorem– BASE.

UNIT III – NOSQL, MONGODB & CASSANDRA

6

NoSQL: Types of NoSQL Databases, Advantages of NoSQL, SQL versus NoSQL, NewSQL, Comparison of SQL, NoSQL and NewSQL.

Introduction to MongoDB - Using JSON, Creating or Generating a Unique Key, Terms used in RDBMS and MongoDB - Data Types in MongoDB – CRUD: Commands- Arrays- MapReduce Functions. Introduction to Cassandra: Features, CQL, CQLSH, CRUD - Comparisons of DB.

UNIT IV – INTRODUCTION TO R & OCTAPARSE 6

Introduction to R - Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

Introduction to Octaparse - web scraping - Scrape category: Pagination - Extract data from sites precisely, XPath generator. Regular Expressions.

UNIT V - SPARK 6

Introduction to Spark: Evolution of Apache Spark - Features of Apache Spark - Spark Built on Hadoop - Components of Spark - Resilient Distributed Datasets - Iterative Operations on MapReduce - Data Sharing using Spark RDD - Interactive Operations on Spark RDD.

TOTAL: 60 periods

N. Learning Resources**i) Text Books**

1. Seema Acharya and Subhashini C: Big Data and Analytics, First Edition, Wiley India Pvt. Ltd, 2015.
2. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman: Big data for dummies – Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, Wiley India Pvt. Ltd, April 2013.
3. An introduction to R: A programming Environment for Data Analytics and graphics version 3.6.1(2019-07-05) W.N. Venables, D.M Smith and the R Team.

ii) Reference Books

1. Spark for Data Science, Srinivas Duvvuri, Bikramaditya Singhal, 2016, PacktPublishing Ltd.
2. Dirk Deroos, Paul C.Zikopoulos, Roman B.Melnyk, BruceBrown: Hadoop for dummies, wiley publications, 2014

iii) Web References.

1. {HYPERLINK "https://spark.apache.org/docs/latest/quick-start.html"}

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2. {HYPERLINK "https://www.octoparse.com/file/octoparse_doc.pdf"}
3. {HYPERLINK "https://cran.r-project.org/doc/manuals/r-release/R-intro.pdf"}

Lab Experiments: Total: 30

Task 1. Hadoop Installation.

- a. A first MapReduce program
- b. Compiling a MapReduce program
- c. Running Hadoop jobs locally

Task 2. Installation of Mongo DB with CRUD Operation in MongoDB.

- a. Create
- b. Read
- c. Update
- d. Delete

Task 3. Mongo DB Query Language and java Connectivity

Task 4. MongoDB query to display all the documents

Task 5. Getting Used to R: Describing Data

- a. Viewing and Manipulating Data
- b. Plotting Data
- c. Reading in Your Own Data

Task 6. Describing and Comparing Two or More Data Sets using R.

- a. Experimental Data
- b. Boxplots
- c. A Factorial Design
- d. Observational Data

Task 7. Octaparse

- a. Extract data from webpage.
- b. Working with XPath.

Task 8. Installation Hive

- a. Hive functions.
- b. Process data in Hive.
- c. HDFS commands.

Task 9. Apache Spark

- a. Installation of Spark.
- b. Installation of Scala.

- c. Spark Shell.
- d. Processing in RDD.

Task 10. Implementation of Word count example using Spark Core API

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS195	UI and UX Design	3	0	0	3

A. Preamble:

UI and UX plays vital a role in the design market. Many companies try to attract the users by studying and reviewing the user experience. According to the user interest the UI has been designed to increase the sales. This satisfy the end user with pleasant look and easy to use. This course introduces the basics behind UI and UX

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150GE102	Design Thinking

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS202	Internet Programming

D. Course Educational Objectives:

Learners are exposed to

- Describe the User Interface
- Describe the User Experience
- Learn what are the relevant tools for UX Designers

E. Course Outcomes:

Upon the successful completion of the course, students will be able to

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Describe UI and UX design by their own way	K2
CO2	Build their different type of prototyping	K2
CO3	Fetch all UI Elements in designed page	K2
CO4	Design the Personas by their own way	K3
CO5	Conduct a Usability Test and submit the Test Results Report	K3

F. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M	M					L		M					
CO2	M	M			M				H	L			L		L
CO3	L		M					L						M	
CO4		M			L			M				L		L	M
CO5	H			M		L				M		M	L		

H- High; M-Medium; L-Low

G. Course Content:

Unit I Introduction

9

Introduction - What is UX Design? - What is UI Design? - What is Interaction Design – UX Design Deliverables - Basics of HCI

UX Design - User Centered Design - Design Thinking - Activity Based Design - Agile Process - User Research - Competitor Analysis

Unit II Interaction Design

9

Interaction Design - Ideation Methods - Interaction & Prototyping - Paper Prototyping - Build your own Prototyping - Heuristic (Expert) Evaluation - Designing a Web / Mobile App

Unit III Visual Design

9

Visual Design - Web App UI Elements - Mobile App UI Elements - Grid Systems - Colors Theory and Palette - Understanding Typography - Material UI and other UI Kit

Unit IV User Research

9

User Research - How to conduct user Interviews - User Research - Creating Personas - Empathy Mapping - Information Architecture - Building User Journey Maps

Unit V Usability Testing

9

Usability Testing - Testing Methods - User Testing - A/B Testing - Conducting a Usability Test - Test Results Report

Lab Experiments:

Interaction Design

Task1 Install a Adobe XD and apply all features

Task2 Create the design via paper prototyping Apps

Task3 Build the own prototyping with Adobe XD

Task4 Designing the own Web / Mobile App

Visual Design

Task1 Create and design the UI Elements

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- Task2 Implement all UI Elements in the Web App / Mobile App
- Task3 Understand the Grid System and implement the Web App / Mobile App
- Task4 Implement colors Theory and Typography in your own Web App/ Mobile App Through Material UI and other UI Kit

User Research

- Task1 Post personas with your image and collective information
- Task2 Create the own idea with Empathy Mapping

Usability Testing

- Task1 Conduct a user testing and Usability testing
- Task2 Submit the Test result report

TOTAL: 45 Hours

H. Learning Resources

i. Text Books:

1. {HYPERLINK
"https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Rex+Hartson&search-alias=stripbooks"}, Pardha S. Pyla, "The UX Book: Agile UX Design for a Quality User Experience", Morgan Kaufmann; 2nd edition, 2019.
2. Adam Boduch, " React Material-UI Cookbook: Build captivating user experiences using React and Material-UI", Packt Publishing Limited, 2019.

ii. Reference Books:

1. Will Grant, "101 UX Principles: A definitive design guide", Packt Publishing Limited, 2018
2. {HYPERLINK
"https://www.amazon.in/s/ref=dp_byline_sr_book_1?ie=UTF8&field-author=Brian+Sullivan&search-alias=stripbooks"}, "The Design Studio Method: Creative Problem Solving with UX Sketching", Routledge, 2017
3. Ellen Lupton, "Thinking with Type: A Critical Guide for Designers, Writers, Editors, & Students", Princeton Architectural Press; Revised, Expanded edition, 2014

iii. Online resources:

1. <https://uxplanet.org>
2. <https://uxdesign.cc>

iv. MOOCs:

1. <https://www.coursera.org/specializations/ui-ux-design>
2. UX Design & User Experience Design Course - Theory Only:
<https://www.udemy.com/course/how-to-change-careers-and-become-a-ux-designer/>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS196	UiPath: Robotic Process Automation	3	0	0	3

A. Preamble:

Enhance the students understanding on business process identification and its automation. Provide the students with an environment in which they can explore the usage and usefulness of software development to increase efficiency in business processes. Induce a realistic and industry driven view of software development for business process automation related concepts and their inherent benefits.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS117	Java Programming

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS202	Internet Programming

D. Course Educational Objectives:

Learners are exposed to

- Give students the ability to explore various ways to automate business processes.
- Improve the students' abilities to tackle on goal driven process automation.
- Enhance the students understanding of process automation value in business.
- Students will be able to use various tools, e.g., UiPath Studio, in order to provide a process automation solution.
- Students will be able to design and develop a business process automation solution following specific requirements and real-world case studies available on RPA learning platforms.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Apply rules to organized and efficient work, responsibilities of didactical and scientific activities and creative capitalization of own potential, while respecting principles	K3

	and rules for professional ethics.	
CO2	Identify adequate software systems development methodologies.	K3
CO3	Use efficient methods and techniques for learning, knowledge gaining, and research and develop capabilities for capitalization of knowledge, accommodation to society requirements and communication in English.	K3
CO4	Identify models and methods adequate to real life problem solving.	K3
CO5	Develop the real time project, testing and deployment.	K3

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M			M								L		
CO2	M	M			M								L	M	
CO3	M	M			M								M	M	
CO4	M	M			M								M	M	
CO5	M	M			M								M		

H- High; M-Medium; L-Low

G. Course Content:

Unit I Introduction

9

Basic concepts - UiPath Platform Architecture-Business Process - **Business Process Identification** **Introduction to UiPath Studio**-Variables, Data types - Control flow structures. Data processing Operations on Data - Entry, Update, Validation – Migration- Data manipulation - Scalar variables, Collections. Tables - Text manipulation- Gathering and assembling data

Unit II User Events and Recorder

9

Desktop recording- Web recording - Input/output methods - Screen scraping -Data scraping - **Selectors** - Definition and access - Customization and debugging - Dynamic selectors

Unit III Image and Test Automation

9

Basic Citrix Automation – Keyboard Automation – Information Retrieval - Advanced Citrix Automation - Best Practice Rules – Starting Applications – **Excel, Data Tables** - Basic Interactions - Data Process, **PDF and E-mail** – Data Extraction - Anchor base

Activity - E-mail interaction -E-mail sending.

Unit IV Debugging and Exception Handling	9
UiPath debugging tools - Input issues - Error catching – Orchestrator- Basics - Features	
Jobs scheduler - Queues	

Unit V Project Organization and Final considerations

9

Project Organization - Best practices - Invoke Command – Examples – **Testing and Deployment** - Testing the RPA Solution - Deploying an RPA Solution - **Final considerations** - ROI with RPA - Emerging and Future Trends in RPA

H. Lab Experiments:

RPA Basic

Task 1: UiPath Studio installation

Task 2: RPA project setup

Events and Recorder

Task 3: Repetitive business process identification

Task 4: Automation plan

Image and Test Automation

Task 5: Project input

Task 6: Data processing

Task 7: UI interaction

Task 8: Image and Text Automation

Task 9: PDFs and E-mail Automation

Project Organization and Testing

Task 10: Project output. Project outcome

Task 11: Project turn-in/Demo

Tools:

1. UiPath Studio
2. UiPathRobot

TOTAL: 45 Hours

I. Learning Resources

i. Text Books:

1. Alok Mani Tripathi, "Learning Robotic Process Automation", Publisher: Packt

ii. Reference Books:

1. Frank Casale (Author), Rebecca Dilla (Author), Heidi Jaynes (Author), Lauren Livingston (Author), "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation.
2. Richard Murdoch, "Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant".
3. SrikanthMerienda, "Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation".

iii. Online resources:

1. <https://www.uipath.com/rpa/robotic-process-automation>

iv. MOOCs

1. {HYPERLINK
"https://academy.uipath.com/learn/course/external/view/elearning/640/RPADeveloper-ProductionReadyEssentials"}
2. {HYPERLINK
"https://academy.uipath.com/learn/public/learning_plan/view/35/RPADeveloper"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS197	Front End Technologies; Node JS, Angular JS	3	0	0	3

A. Preamble:

Front-end is a term that involves the building of web pages and user interfaces for web applications. It implements the structure, design, behaviour, and animation of everything an user see on the screen when the user pen up websites, web applications, or mobile apps. The core 4 technologies that all modern front-end web developers work to master are Angular JS, Node.js, Typescript and MongoDB. Develop the single page

application and makes it more responsive to user actions. Websites built on Angular JS typically load faster and also it gives the permission to add specialized features to the websites which would otherwise take much longer to create.

B. Prerequisite:

Sl. No	Course Code	Course Name
1	1151CS117	Java Programming

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS107	Database Management System

D. Course Educational Objectives:

Learners are exposed to

1. Develop the web server to handle I/O Bound application.
2. Design a schema less document type database.
3. Develop a javascript framework used for building MVC based applications.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Create web server with dynamic web page content.	K3
CO2	Generate Query in MongoDB and make connectivity to Node.js and Angular JS	K3
CO3	Develop the basic building blocks of the web page using JavaScript.	K2
CO4	Understand the components and directives used to perform operation in web applications.	K3
CO5	Design Model Driven Forms and Single page web application using Angular JS.	K3

F. Correlation of COs with POs :

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		H					M	H	L	M			M	H
CO2									M		M				
CO3									M		M				
CO4	H		H		H	M		M	H	M	H			H	H
CO5	H		H	M	H	M		H	H	H	H	M		H	H

H- High; M-Medium; L-Low

G. Course Content:

Unit I Introduction to Server-side JS Framework – Node.js 9

Introduction to Node.js – Architecture – Feature of Node.js - Creating web servers with HTTP (Request & Response) – Event Handling - GET & POST implementation

Unit II Introduction to NoSQL Database – MongoDB 9

Introduction – Key Characteristics and usecase – Scheme design and Data Modelling – Atomic operations –Connection to MongoDB – Implementation of CRUD Operations

Unit III Introduction to Type Script 9

Introduction to TypeScript – Features of TypeScript – Variables – Datatypes – Enum – Array – Tuples – Functions – OOP concepts – Classes – Interfaces – Inheritance

Unit IV Introduction to Client-side JS Framework – Basics of Angular 4.0

9

Introduction to Angular 4.0 – Features – Components and Templates – Modules – Built in Directives – HTTP

Unit V Forms and Routing in Angular 4.0

9

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H. Lab Experiments:

Task 1. Installation and setup of Node.js and MongoDB

{PAGE }

- Task 2. Building an express web server
- Task 3. Use Get & Post method in web server
- Task 4. Connect to NoSQL Database using Node.js
- Task 5. Implementation of CRUD operations
- Task 6. **Installation and setup of Angular4.0 and Typescript**
- Task 7. **Form creations using Decorators and Generics**
- Task 8. **Develop Video Streaming Websites using nested components**
- Task 9. **Develop User – Review Websites**
- Task 10. **Develop User generated content websites**
- Task 11. REST services and Routing
- Task 12. Animation

Tools: Node.js Version 12, Angular 4.0, Typescript

TOTAL: 45 Hours

I. Learning Resources

i. Text Books:

1. Greg Lim "Beginning Node.js, Express & MongoDB Development", July 2019. [Unit I].
2. Alex Giama s, "Mastering MongoDB 4.x", second Edition, Packt Publishing 2019 [Unit -II].
3. Nathan Rozentals,"Mastering TypeScript 3: Build Enterprise Read, Industrial Strength web Application using Typescript 3 and Modern Frameworks", 3rd Edition, Kindle Edition Feb 2019 [Unit -III].
4. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" 2017 [Unit -IV, V].

ii. Reference Books:

1. Krishna Rungta, "Angular JS" kindle Edition 2018.
2. Andrew Mead, "Advanced Node.js Development" packt Publishing, 2018.
3. Boris Cherny, "Programming Typescript: Making Your Javascript Application scale", Kindle Edition, 2019.

iii. Online resources:

- 1 Web link for TypeScript: {HYPERLINK "about:blank"}
- 2 Web link for Angular4.0: {HYPERLINK "about:blank"}
- 3 Web link for Node.js : {HYPERLINK "about:blank"}
- 4 Web link for MongoDB: {HYPERLINK "about:blank"}

iv. MOOCs

1. {HYPERLINK "about:blank"}
2. {HYPERLINK "about:blank"}?
3. {HYPERLINK "about:blank"}
4. {HYPERLINK "about:blank"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS198	CLOUD COMPUTING CONCEPTS	3	0	0	3

Course Category: Program Elective

A. Preamble :

Cloud computing is an emerging computing paradigm where various users access the resources and services offered by service providers. Use of cloud computing at this course encompasses the production services and it can offer benefits in the cost, performance, and delivery of IT services. The use of cloud computing services is forecast to grow significantly over the coming years.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1151CS103	Programming in Java

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS101	Cryptography and Network Security

D. Course Educational Objective:

Students undergoing this course are expected:

- Access cloud resources and services needed to perform functions with dynamically changing needs.

- Understand the cloud privacy and security concepts to create secure cloud environment.
- Learn the various cloud platforms to implement real time cloud applications.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Outline the various cloud service delivery and deployment models.	K2
CO2	Interpret the role of virtualization in cloud environment.	K2
CO3	Explain the various private cloud deployment models.	K2
CO4	Explain the cloud service working models in public cloud environment.	K2
CO5	Relate the cloud security with traditional security to adapts the future trends of Cloud Computing	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			L								L	L	
CO2	M	M			M								M	M	
CO3		L			M									M	
CO4		M			M									M	
CO5		L			M									M	

G. Course Content:

Unit I Overview of Cloud Computing, Parallel and Distributed Computing

9

Brief history and evolution - History of Cloud Computing, Evolution of Cloud Computing, Traditional vs. Cloud Computing. Why Cloud Computing, Cloud service models (IaaS, PaaS & SaaS). Cloud deployment models (Public, Private, Hybrid and Community Cloud), Benefits and Challenges of Cloud Computing. Introduction to AWS Public Cloud Vendor.

Unit II Virtualization

9

Introduction – Characteristics of Virtualized Environments, Taxonomy of Virtualization Techniques, Virtualization and Cloud Computing, Pros and Cons of Virtualization, Types of Virtualization, Virtualization of CPU, Memory, I/O Devices - Desktop Virtualization – Server Virtualization. Technology Examples: Xen: Paravirtualization, VMware: Full Virtualization and Microsoft Hyper-V.

Unit III Cloud Architecture and Programming Tasks 9
Distributed File systems leading to Hadoop file system, introduction, Using HDFS, Hadoop Architecture, Internals of Hadoop File Systems.

Map-Reduce Programming: Developing Distributed Programs and issues, why map-reduce and conceptual understanding of Map-Reduce programming, Developing Map-Reduce programs in Java, setting up the cluster with HDFS and understanding how Map- Reduce works on HDFS, Running simple word count Map-Reduce program on the cluster, Additional examples of M-R Programming.

Anatomy of Map-Reduce Jobs: Understanding how Map- Reduce program works, tuning Map-Reduce jobs, understanding different logs produced by Map-Reduce jobs and debugging the Map- Reduce jobs.

Unit IV Cloud Platforms in Industry 9
AWS: Compute Services, Storage services, Communication Services, Additional Services.
Google AppEngine: Architecture and Core Concepts, Application Life Cycle, Cost Model.
Microsoft Azure: Core Concepts, SQL Azure, Windows Azure Platform Appliances.

Unit V Cloud Applications, Service Efficiency and Cloud Security 9
Scientific Applications: Healthcare, Biology, Geoscience. Business and Consumer.
Applications: CRM & ERP, Productivity, Social Networking, Media Applications, Multiplayer Online Gaming. Energy Efficiency in Clouds, Market Based Management of Clouds, Federated Clouds / Inter Cloud, Third Party Cloud Services – MetaCDN, SpotCloud. **Security Overview :** Cloud Security Challenges – Software-as-a-Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.

H. Lab Experiment

Virtualization

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Program.
3. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
4. Find a procedure to transfer the files from one virtual machine to another virtual machine.
5. Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.
6. Implementation of Para- Virtualization using VM ware's workstation/ Oracle's Virtual Box and Guest O.S.

Programming Model

- Task1. Install Hadoop single node cluster and run simple applications like wordcount.
- Task2. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim
- Task3. Use GAE launcher to launch the web applications.
- Task4. Use Eucalyptus or Open Nebula or equivalent to set up the cloud and demonstrate

Cloud platform in Industry

- Task1. Install Google App Engine. Create hello world app and other simple web applications using python/java.
- Task2. Creating a Warehouse Application in Sales Force.com.

Cloud application

- Task1. Create a word document of your class timetable and store locally and on the cloud with doc, and pdf format. (use www.zoho.com and docs.google.com)
- Task2. Create a spread sheet which contains employee salary information and calculate gross and total sal using the formula DA=10% OF BASIC HRA=30% OF BASIC PF=10% OF BASIC IF BASIC<=3000 12% OF BASIC IF BASIC>3000 TAX=10% OF BASIC IF BASIC<=1500 =11% OF BASIC IF BASIC>1500 AND BASIC<=2500 =12% OF BASIC IF BASIC>2500 (use www.zoho.com and docs.google.com) NET_SALARY=BASIC_SALARY+DA+HRA-PF-TAX
- Task3. Prepare a power point on cloud computing -introduction , models, services ,and architecture power point should contain explanations, images and at least 20 pages (use www.zoho.com and docs.google.com)
- Task4. Create your resume in a neat format using google and zoho cloud

- Task5. Write a Google app engine program to generate n even numbers and deploy it to google cloud
- Task6. Google app engine program multiply two matrices
- Task7. Google app engine program to validate user ; create a database login(username, password) in mysql and deploy to cloud
- Task8. Write a Google app engine program to display nth largest number from the given list of numbers and deploy it into google cloud.
- Task9. Google app engine program to validate the user ,Use mysql to store user info and deploy on to the cloud.

TOTAL: 45 Hours

I. Learning Resources:

i. Text Book:

1. RajkumarBuyya, Christian Vecchiola, S. ThamaraiSelvi, " Mastering Cloud Computing", McGraw-Hill Education (India) Private Limited, 2017.

ii. Reference Books:

1. Thomas Erl, Zaigham Mahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology & Architecture", ServiceTech Press, 2014. ISBN-13: 978-0-13-338752-0.
2. Tom White,Hadoop: The definitive Guide by Tom White, 3rd Edition, O'reily.

iii. Online References:

1. Prof. SowmyaKanti Ghosh, in Cloud Computing, NPTEL [Online], 2017. Available: {HYPERLINK "about:blank"}. [Accessed May 25,2019]
2. Jithin_Mankad, Ravi Ganapathy, in Cloud Computing, InfyTq Infosys [Online], 2019. Available: {HYPERLINK "about:blank"}[Accessed May 25,2019]

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS314	PRINCIPLES OF PROGRAMMING LOGIC	0	0	2	1

H. Preamble :

This Course provides the way to trace the code using pen and paper handy. The Students are expected to understand the syntax and semantics of programming languages. Also the students are expected to carry out the tasks mentioned below which in turn helps them to develop their logic building skills.

I. Prerequisite Courses:

S. No	Course Code	Course Name
1	1150CS101	Problem Solving Using C
2	1151CS102	Data Structures

J. Course Outcomes :

After successful completion of this course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Trace the code and develop in depth understanding of functional, logic and object oriented programming paradigm.	S3
CO2	Debug the program / code segment which includes syntax and semantic errors.	S3
CO3	Understand design/implementation issues involved with variable allocation, control flow, types, sub routines	S3
CO4	Solve mathematical problems using programs and to reduce time complexity.	S3

D. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H	M			H			H				M	M	M
CO2		M			M	M			M					M	H
CO3			H	M	M	M			M					H	M
CO4	H	H	M	M		H			H				M	H	H

H- High; M-Medium; L-Low

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS315	MACHINE LEARNING TECHNIQUES LAB	0	0	2	1

Course Category: Program Elective

A. Preamble:

This course helps to learn the application of machine learning algorithms in real life examples. It guides the usage of tools that are needed to implement programs capable of learning from data. It introduces Python framework Scikit-Learn that makes a great entry point to learn Machine Learning.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS140	Machine Learning Techniques
2	1150MA201	Applied Statistics.

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Learners will

- Understand python framework for machine learning
- Make robust Machine Learning models
- Make predictions of the model
- Know which Machine Learning model to choose for each type of problem

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's taxonomy)
CO1	Preprocessing the data for machine learning	K3
CO2	Implement algorithms for prediction tasks	K3
CO3	Analyze the performance of classification algorithms	K3
CO4	Demonstrate suitable machine learning algorithms for clustering tasks	K3
CO5	Reduce the dimensionality of the training data to fight the curse of dimensionality.	K3

F. Correlation of Cos with Pos:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		M	M		M										
CO2	M	H	H	H	H				L	M			M	M	M
CO3	M	H	H	H	H				L	M			M	M	M
CO4	M	H	H	H	H				L	M			M	M	M
CO5	M	M	M	H	H					M			M	M	

G. Course contents

Lab Experiments:

Task 1: Basics of python and Introduction to Anaconda-Spyder Interface

Task 2: Prepare data for machine learning

Task 3: Demonstrate linear Regression for a prediction task

Task 4: Apply Multiple Linear Regression and evaluate its performance

Task 5: Build a Binary Classifier using Decision Tree Algorithm

Task 6: Use the Tensor Flow library to build and train neural nets

Task 7: Apply k-means algorithm for clustering task

Task 8: Using Agglomerative algorithm generate dendrogram from the given dataset

Task 9: Perform feature selection using Backward Elimination Algorithm

Task 10: Demonstrate Dimensionality Reduction using PCA Algorithm

Task 11: Experiment LDA Algorithm for supervised classification

Task 12: Apply Factor Analysis technique for feature extraction

Task 13: Analyze Performance of classifier using k-fold cross validation technique

H. Learning Resources:

i. Text Book

4. urelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, O'Reilly Media, Inc., 2019
5. Andreas Muller, "[https://www.amazon.in/Introduction-Machine-Learning-Python-Scientists/dp/9352134575/ref=sr_1_3?adgrpid=58677648693&ext_vrnch=hi&gclid=EAIAIQobChMloMqK-q6g5QIVgo2PCh19kATLEAMYAiAAEgIFzPD_BwE&hvadid=35639407332&hvdev=c&hvlocphy=9061923&hvnetw=g&hvpos=1o2&hvqmt=e&hvran=d=3130914338320543206&hvtargid=kwd-295090772533&hydadcr=18007_1938119&keywords=hands+on+machine+learning&qid=1571214799&sr=8-3" \t=_blank">}](https://www.amazon.in/Introduction-Machine-Learning-Python-Scientists/dp/9352134575/ref=sr_1_3?adgrpid=58677648693&ext_vrnch=hi&gclid=EAIAIQobChMloMqK-q6g5QIVgo2PCh19kATLEAMYAiAAEgIFzPD_BwE&hvadid=35639407332&hvdev=c&hvlocphy=9061923&hvnetw=g&hvpos=1o2&hvqmt=e&hvran=d=3130914338320543206&hvtargid=kwd-295090772533&hydadcr=18007_1938119&keywords=hands+on+machine+learning&qid=1571214799&sr=8-3), O'Reilly Media, Inc., 2016.

ii. Online Resources

1. [https://learnpython.org/](http://learnpython.org/)
2. <https://github.com/ageron/handson-ml>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS316	PYTHON PROGRAMMING LAB	0	0	2	1

Course Category: Program Elective

A. Preamble:

This course focuses on developing the python programming to do a variety of programming tasks where the students are encouraged to develop application. At the end of the course the student will be developing adequate skills in programming and will be known to understand the implementation of various applications using python in different IDE.

B. Pre-requisites:

S1. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

S1. No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Educational Objectives:

Students undergoing this course are exposed to:

- Understand why Python is a useful scripting language for developers
- Learn how to design object-oriented concepts with python classes
- Learn how to design and program python gaming applications using turtle
- Establish client server communication using python

E. Course Outcomes:

Students undergoing this course are able to

CO Nos	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Write, Test and Debug Python Programs using various data types	K3, S3
CO2	Implement Conditionals and Loops for Python Programs & perform read and write operation from & to files in Anaconda or Spyder.	K3, S3
CO3	Implement various oops concepts using classes, methods, Objects and control structures.	K3, S3
CO4	Use functions and modules to perform various image processing tasks and graphics in Jupyter.	K3, S3

CO5	Implement networking concepts for client server programming and HTML server	K3, S3
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F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	H			H				L				L	M	
CO2	M	H			H				L					M	
CO3	M	H			H				L						M
CO4	H	H	H		H				H		H			H	H
CO5	H	H	H		H				H		H			H	H

G. Course Content

LIST OF EXPERIMENTS

Task 1: Running various expressions in Interactive interpreter and a Python Script.

Task 2: Identifying different types of Error and correct the error in the existing code.

Task 3: Scientific problem-solving using conditional statements, loop controlled statements

and looping.

Task 4: Python Programming to implement various data types String, List, Tuples and Dictionary

Task 5: Implement various Searching and Sorting Operations in python programming

Task 6: Implement various text file operations.

Task 7: Utilizing 'Functions' concepts in Python Programming.

Task 8: Implement Object Oriented Programming Concepts Inheritance, Polymorphism, Data Abstraction and Encapsulation, Method overriding.

Task 9: Implement Exceptions and Exceptional handling in Python.

Task 10: Implement Turtle concepts for drawing various shapes and enabling graphics.

Task 11: Simulate Gaming concepts and image format conversion using Pygame and Jupyter.

Task 12: Demonstrate various concepts learned in python programming for Real time mini project

H. Learning Resources:

i. Text Book:

- Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.

ii. Reference Books:

1. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
2. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
3. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013).

iii. Web Resources

1. {HYPERLINK "http://www.edx.org"}
2. {HYPERLINK "http://cs231n.github.io/python-numpy-tutorial/"}
3. {HYPERLINK "https://www.learnpython.org/"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS317	DATA MINING LAB	0	0	2	1

Course Category: Program Elective

A. Preamble:

The course helps in applying the techniques for pre-processing, data mining algorithms such as Association rule, classification, clustering to analysis the data and to discover knowledge

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS303	Database management system Lab

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Educational Objectives:

Learners will

- Understand the algorithms of data mining by implementing with the real time datasets.
- Acquaint skills by using the recent data mining software for solving practical problems.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Use the datasets and to preprocess the data using various preprocessing techniques.	K3
CO2	Demonstrate the working of Association Rule mining algorithms and to find the relationship between the attributes	K3
CO3	Apply the Classification and Prediction Algorithms to analyse the data	K3
CO4	Apply Clustering Algorithms to analyze the real time data set.	K3

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	H		L					M			H		M
CO2	H	H	H		L					M			H		M
CO3	H	M	M		L					M			M		M
CO4	H	H	H		L					M			M		M
CO5	M	M	M		L					M			M		M

H- High; M-Medium; L-Low

G. Course Content:

List of Experiment:

Task 1: Study on different tools available for mining the data

Task 2: To perform and use Data Pre-processing techniques for the given data set.

Task 3: Implement Apriori algorithm to generate frequent Item Sets

Task 4: Implement FP growth algorithm to generate frequent Item Sets

Task 5: Implement the following classification algorithms

- i. Decision Tree Induction

- ii. K-Nearest Neighbor

- iii. Naïve Bayes Classifier

Task 6: Using neural network for prediction of class

Task 7: Identifying the class labels using Multilayer feed forward neural network

Task 8: Perform a K-means clustering for the given data set

Task 9: Develop/train a linear regression model

Task10: To perform the following mining process

- i. Text mining
- ii. Web mining

H. Learning Resources:

i. Text Books:

1. Mark Gardene, Beginning R: The Statistical Programming Language, Wrox publications, 2012
2. Ian H Witten, Eibe Frank, "Data Mining Practical Machine Learning Tools and Techniques", 2nd Edition, The Morgan Kaufmann Series in Data Management Systems, 2005

ii. Online Resources:

1. {HYPERLINK "http://statweb.stanford.edu/~lpekelis/13_datafest_cart/WekaManual-3-7-8.pdf"}
2. {HYPERLINK "<https://www.hackerearth.com/practice/machine-learning/advanced-techniques/text-mining-feature-engineering-r/tutorial/>"}
3. {HYPERLINK "<https://blog.eduonix.com/internet-of-things/web-mining-text-mining-depth-mining-guide/>"}
4. {HYPERLINK "<https://academy.rapidminer.com/learning-paths/get-started-with-rapidminer-and-machine-learning>"}
5. {HYPERLINK "<https://docs.mongodb.com/manual/tutorial/>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS182	Pattern Recognition	3	0	0	3

Course Category: Program Elective

Course Content:

Introduction to pattern recognition (PR) as a process of data analysis. Practical applications, Representation of features in multidimensional space as random vectors, Feature extraction using image processing, Similarity and dissimilarity measures in feature space, Bayesian decision theory, Discriminant functions and supervised learning, Clustering analysis and unsupervised learning, Feature extraction and selection, Pattern Recognition using Neural Networks., Case studies from Shridhar's research projects.

Note: Pattern Recognition applications often involve extensive image processing. I will discuss specific techniques in my lectures.

Lecture Schedule: 3 lecture hours per week and one two hour MATLAB session per week

Prerequisites: Probability and Statistics, Linear Algebra, Programming in C++, Python or MATLAB

Grading: A group project involving two students on a PR problem (30%), one mid-term exam (30%) and one final exam (40%).

Note: This course is both analytical and practical. Only students possessing prerequisite skills and a level of maturity should enroll in this course. I would like one or two faculty members to act as guides on this course. I will use that opportunity to get selected faculty involved in research and scholarship.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS184	Multiprocessor Programming	2	0	0	2

Course Category: Program Elective

Course Description: This course covers the design and implementation of programming languages and computing systems that support concurrency and parallelism with the following topics: foundations and principles of multiprocessing, the principles of concurrency with mutual exclusion, data races, deadlocks, live locks, serializability, and memory management in multiprocessing systems.

Course Content:

1. Introduction to Multiprocessing Programming.
2. Posix Threads with Synchronization and Mutual Exclusion.
3. Concurrent Objections, Data races, Atomicity violations
4. Spin Locks and Low-Level Atomics
5. Lock-free Data Structures
6. Parallel programming using OpenMP or MPI.

References:

1. Maurice Herlihy & Nir Shavit, *The Art of Multiprocessor Programming*, Morgan Kaufmann..

Lecture Schedule: 2 lecture hours per day and one hour lab

Prerequisites: Assembly Programming, Data Structure and Algorithm Analysis

Grading: Assignment and Final Assessment

Note: This course is both analytical and practical. Attendance and participation in class are required.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS183	IoT Networking Technologies	2	0	0	2

Course Category: Program Elective

Course Description: This course covers the basic, history of IoT devices and Architecture of IoT . Also covers the Connecting smart objects (IoTs), Application Protocols for IoT and Security IoT. For Lab its covers, IoT using Packet Tracer

Course Content:

1. What is IoT.
2. IoT Networks.
3. Connecting smart objects (IoTs)
4. Application Protocols for IoT
5. Security IoT
6. Lab and Quiz on configuring IoTs using Packet Tracer

7. Lab and Quiz on IoT using Packet Tracer

Lecture Schedule: 1 lecture and 2 hour per day

Prerequisites: Computer Networks

Grading: Assignment and Final Assessment

Note: This course is both analytical and practical. Attendance and participation in class are required.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS185	New Game development Paradigm with Unity	2	0	0	2

Course Category: Program Elective

Course Description: In this course we will cover the new Entity Component System (ECS) for Unity game development framework. The new framework presents a significant change to current approach to game development with Unity by forcing us to write high-performance code by default, instead of worrying about performance later. In order to illustrate these new key concepts of ECS, a functional game will be developed fully in ECS.

Student who have some experience in game development with Unity. This course can be taught to them with hands on experience with current programming paradigms in Unity. Alternatively it can be taught at beginner level, concentrating more on basic concepts and less on changes to current programming paradigms in Unity.

Course Content:

1. Create & Apply sprite animations
2. Create a functional level
3. Implement game mechanics
4. Create visual and audio effects

Lecture Schedule: 1 lecture and 2 hour per day

Level: intermediate

Prerequisites: Gaming, Animations

Grading: Assignment and Final Assessment

Note: This course is both analytical and practical. Attendance and participation in class are required.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS186	User-Centered design of the smart campus	2	0	0	2

Course Category: Program Elective

Course Description: In this course we will cover the Introduction about user- centered design, Introduction on H5P. The Course modalities evaluation modes and project definition. And also Tutorial contextual inquiry about the course.

Course Content:

1. Introduction about user- centered design
2. Course modalities
3. Tutorial contextual inquiry
4. Tutorial interpretation
5. Tutorial affinity
6. Tutorial storyboarding

Lecture Schedule: 1 lecture and 2 hour per day

Level: intermediate

Prerequisites:

Grading: Assignment and Final Assessment

Note: This course is both analytical and practical. Attendance and participation in class are required.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS199	Mobile Game Development	2	0	0	2

Course Category: Program Elective

Course Description:

This course will introduce some key elements of game programming by developing a gaming mobile app. The course will examine topics such as user interface design, application accessibility, software services, security and accessibility. This course emphasize basic XML Layout designing, Frame by Frame Animation, Object Oriented concept for animation, detecting touch event and collision, displaying the score and health indicator.

Course Objectives:

Upon the completion of this course, student will be able to do the following:

1. Demonstrate an understanding of the benefits and limitations of mobile applications from both a business and technical perspective.
2. Use object-oriented design and an object-oriented language to develop a gaming mobile app using the Android Studio Development
3. Understand the game development fundamentals
4. Use problem solving and computational skills.
5. Learn to publish and monetize mobile apps in the Android market.

Course Content:

1. Overview of the Mobile Application Concepts and Introduction to Android Game Development (3 hours)
2. Mobile applications tools and techniques (9 hours)
 - Setting up your environment
 - Use of the simulator
3. Mobile Game Application Design (15 hours)
 - i. User Interface Design
 - ii. Graphics/Multimedia
 - Frame by Frame Animation
 - Object Oriented Animation Technique

- iii. Event based programming and collision detection
- iv. Security

4. Game Over and publishing in the Android Market (3 hours)

References:

1. Ed Burnette, Hello, Android 3rd Edition, Pragmatic Bookshelf, May 2010.
2. Walter Savitch, Absolute Java, 6th Edition, Pearson, Pearson, 2016.
3. Android Developers Guide, <https://developer.android.com/guide>, Last Accessed 21

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS192	WINDOWS AND LINUX ADMINISTRATION	3	0	0	3

Course Category: Program Elective

A. Preamble:

This is an introduction to the process of choosing, installing, configuring and maintaining Microsoft Windows client and server systems and as well as Linux Client and Server Systems. Topics include user management, file systems, network domains and domain management. Students get practice in writing scripts for performing maintenance tasks. Also, students learn how these tasks fit into the more general system administration process.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS106	Operating Systems

C. Related Courses:

Sl. No	Course Code	Course Name
1	1151CS111	Computer Networks

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Learn the Windows administration and its operating functionalities
- Learn the Linux system and perform administrative tasks

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the Windows operating system architecture and create Virtual machines	K2
CO2	Configure and manages the device and file system	K2
CO3	Create and maintain tools to manage software and user accounts	K3
CO4	Configure kernel and use Samba to share files across networks in different platforms.	K3
CO5	Understand the network configuration and setting up of Domain Name System	K2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L	L		L								L	L	
CO2	M	M	L	L			L		L				M	M	
CO3		L	M		M				L			L			
CO4		M		M		M	M		M			L		M	M
CO5		L	L		M	M		M				M			M

G.Course Content:

Unit I: Windows Essentials

9 Windows Operating System Architecture – Operating System Configuration- Managing User Account-Configuring and Optimizing User Account Control (UAC) - Configuring Windows setting- Configuring Hyper-V-Virtual Machine - Accessing a Computer Remotely.

Unit II: Windows Device and File Management

9

Managing Services and Disk - MSConfig (System Configuration Utility) - Storage Management – File System Management - File and Printer Sharing - Configuring File

Sharing- FAT and NTFS Permissions- Maintaining, Updating, and Protecting - Exploring Built-in Maintenance Tools - Maintaining the Windows Registry.

Unit III: Windows Security and Linux Software

9

Windows Firewall - Local, Network, and Automated Backup Methods - Configuring System Recovery. Linux Operating System Concepts and Architecture- Manage Software – RPM, Debian, APT, GNU, Managing Users - User Management and Access Permissions - Pluggable Authentication Modules (PAM)

Unit IV: Linux System Kernel and File System

9

The Command Line – BASH - Files – Types - Ownership - Permissions- Management and Manipulation - Mounting and Unmounting Disks - Adding a New Disk. Compiling the Linux Kernel- Kernel Source Code- Building the Kernel - Samba- The Mechanics of SMB – Samba administration. LDAP Basics.

Unit V: Linux Network Configuration

9

TCP/IP for System Administrators – A Complete TCP Connection-Bringing IP Networks Together - IPv6. Network Device Configuration Utilities (ip and ifconfig) - Linux firewall-Installing and Configuring Netfilter – DNS-Installing and Configuring a DNS Server, FTP, Network File System-Configuring NFS Server and Clients.

H. Lab Experiments:

1. Find a procedure to transfer the files from one virtual machine to another virtual machine.
2. Configuration of DNS in Windows
3. Firewall Configuration in Windows
4. Configuration of IIS Services in Windows.
5. Kernel Configuration for Linux.
6. Installation of Linux OS and user administration
7. Configuration of DHCP in Windows
8. Setting up of DNS in Linux
9. Creation of Linux and Windows based Virtual Machines and setting up communication between them
10. Configuration Linux Firewall

I. Learning Resources:

i. Text Books:

1. Crystal Panek, "Windows Operating System Fundamentals Publication", John Wiley & Sons 2019.
2. Wale Soyinka "Linux Administration A Beginners Guide", sixth edition, 2017, Mc Graw Hill.

ii. Reference Books:

1. How to Cheat at Windows System Administration Using Command Line Scripts (How to Cheat) 1st Edition by Pawan K. Bhardwaj, {HYPERLINK "https://www.amazon.com/s/ref=dp_byline_sr_book_2?ie=UTF8&field-author=Dave+Kleiman&text=Dave+Kleiman&sort=relevancerank&searchalias=books"} ISBN-10: 1597491055
2. Tom Adelstein and Bill Lubanovic, Linux System Administration, O'Reilly Media, Inc., 1st Edition, 2007. ISBN-10: 0596009526 | ISBN-13: 978-0596009526

iii. Online References

1. Web source for Linux Administration:
<https://www.coursera.org/courses?query=linux>
2. Web source for Windows Administration:
<https://www.microsoft.com/en-us/learning>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS187	DIGITAL FORENSICS METHODS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will address methods to properly conduct a digital forensics investigation. It includes digital evidence collection and evaluation of network and host system intrusions with hands-on use of powerful forensic analysis tools

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1151CS111	Computer Networks
2	1152CS101	Cryptography and Network Security

C. Related Courses:

Sl No	Course Code	Course Name
1.	1152CS161	Cyber Forensics
2.	1152CS158	Cyber Security
3.	1152CS128	Forensics and Cyber Applications

D. Course Educational Objectives:

Students undergoing this course are familiarized to:

- Introduction to Digital Forensics and Crimes
- Digital Forensic and Digital Evidences
- Digital Forensic Approaches and Forensic Duplication
- Forensic Tools and Incident Response
- Network Forensics

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised)

		Bloom's Taxonomy)
CO1	Outline and Explore the fundamentals of Digital Forensics and Crimes	K2
CO2	Know the methods of Digital Forensic and Digital Evidences	K2
CO3	Articulate the Approaches of Digital Forensics and Forensic Duplication	K2
CO4	Compare Different Digital Forensics Tools and Incident Response	K2
CO5	Classify the technology with Network Forensic	K3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	L				L	L	L							L
CO2	M	M	L			M	L						L		
CO3	M	M		M		M	L	L				L	M		L
CO4	M	H		L	L	M	L		L			L	M	L	M
CO5	L	L				L	L								L

H- High; M-Medium; L-Low

G. Course Content:

Unit I: Introduction to Digital Forensics

9

Introduction to Digital Forensics - Categories and Types of Cybercrime - History of Forensic - Rules of Computer/Digital Forensic - The Internet Spawns Crime - Worms Versus Viruses - Role of Computers in Crimes – Digital crime Statistics in India - Prevention of Digital crime **File & Disk Analysis** – Forensic analysis of File Systems, Storage Fundamentals.

Unit II: Digital Forensic and Digital Evidences

9

Digital Forensic - Digital Forensic as a Discipline - Digital Forensic Investigations - Goal of Digital Forensic Investigation - Various DFI Process/Models/Framework - Ethical Issues - **Digital Evidence** - Rules of Digital Evidence - Characteristics of Digital Evidence - Types of Evidence - Challenges in Evidence Handling - Volatile Evidence - Evidence Handling Procedures - Legal Principles of Digital Evidence - Digital Evidence and Metadata.

Unit III: Digital Forensic Approaches and Forensic Duplication 9

Introduction - Policy and Procedure Development - Evidence Assessment Evidence Acquisition - Evidence Examination - Documenting and Reporting - **Introduction to Forensic Duplication** - Rules of Forensic Duplication (Thumb Rule) - Necessity of Forensic Duplication - Forensic Duplicates as Admissible Evidence - Important Terms in Forensic Duplicate - Forensic Duplication Tool Requirements - Creating a Forensic Duplicate of a Hard Drive - Creating a Qualified Forensic Duplicate of a Hard Drive.

Unit IV: Incidence Response and Tool 9

Incidence Response Goals of Incident Response - People Involved in Incident Response Process - Incident Response Methodology - Activities in Initial Response - Phases after Detection of an Incident - Report Writing and Presentation - **Tools** :Internet and E-Mail Examinations - Mobile Forensics Tools – Write Blockers -Imaging – Visual Analysis – Secured Storage – Damaged Media.

Unit V: Network Forensic 9

Introduction to Network Forensic - E-Mail Forensic - Mobile Phone Forensics - Computer Forensics – Cloud Forensic -Anti-Forensics.

H. Learning Resources

i. Text Books:

1. Nilakshi Jain and Dhananjay R Kalbande, "Digital Forensic: The Fascinating World of Digital Evidences", Wiley Press, 2017 (Unit1,2,3)
2. Greg Gogolin, "Digital Forensics Explained", CRC Press Taylor and Francis Group, 2013 (Unit 4,5)

ii. Reference Books:

1. {HYPERLINK "https://bookauthority.org/author/Nhien-An-Le-Khac" \t "_blank" \h}, "Security, Privacy, and Digital Forensics in the Cloud" Wiley Press, 2019, ISBN-13: 978-1119053286ISBN-10: 1119053285.
2. {HYPERLINK "https://bookauthority.org/author/Nihad-A.-Hassan" \t "_blank" \h}, :"Digital Forensics Basics {HYPERLINK "https://www.amazon.com/Digital-Forensics-Basics-Practical-Windows/dp/1484238370?tag=uuid10-20" \t "_blank" \h}", Apress Publishers, 2019.
3. Mike Sheward" Digital Forensic Diaries" Secureowl, 2017 , ISBN: 9781521514467.
4. Gerard Johansen, "Digital Forensics and Incident Response A practical guide to deploying digital forensic techniques in response to cyber security incidents".

iii. Online resources

1. <https://online.norwich.edu/academic-programs/resources/5-steps-for-conducting-computer-forensics-investigations>
2. <http://resources.infosecinstitute.com/computer-forensics-tools>
3. <http://www.cybrary.it/course/computer-hacking-forensics-analyst>

iv. MOOCs

1. <https://www.open.edu/openlearn/science-maths-technology/digital-forensics/content-section-0?active-tab=description-tab>
2. <https://www.itmasters.edu.au/free-short-course-digital-forensics/>
3. <https://www.cs.nmt.edu/~df/lectures.html>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS189	Web and Mobile analytics	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will provide an introduction to Web and mobile analytics, with the analytics tools to develop our business.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS114	Data Warehousing and Data mining

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS140	Machine Learning Techniques
2	1152CS172	Deep Learning

D. Course Educational Objectives:

Learners will

- Study the Web Analytics in both online/offline patterns and trends.
- Gain a knowledge to collect, measure, report, and analyze your website data

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss about the Web analytics and to develop the business	K2
CO2	Show and explain the Google Analytics and setting bench markings.	K2
CO3	Demonstrate the Ecommerce strategy, setting and analysis of various types of goals	K2
CO4	Summarize the basic concepts of Mobile Analytics	K2
CO5	Discuss about the Mobile App analytics	K2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	H									M		M		

CO2	H	H			M					M		M		
CO3	H	H			H					M		M		
CO4			M	H						M			M	
CO5			M	M	H					M	M		M	M

H- High; M-Medium; L-Low

G. Course Content:

Unit -I

9

Introduction to Web analytics -Terminology in web analytics–Support: Small businesses - Medium and largescale businesses - Analysis vs intuition –Google analytics: Getting started with Google Analytics - How Google Analytics works - Accounts, profiles, and users

Unit -II

9

Navigating Google Analytics - Basic Metrics - Main Sections of Google Analytics reports - Traffic Sources - Direct, referring, and search traffic – Campaigns - AdWords, Adsense - Pages and Landing Pages - Event Tracking and AdSense - Site Search - Unique visitors - Geographic and language information - Technical reports - Benchmarking

Unit - III

9

Goals and ecommerce – Setting up goals –Types of goals - Goal reports - Ecommerce tracking - Recap of Google Analytics reports and tools - Getting the organization involved - Creating a data-driven culture - Resources

Unit -IV

9

Introduction Mobile Analytics – Types of mobile analytics – Mobile Market places - Making better decisions - Triangulating Mobiles - Workflow management –Metrics for mobile analytics - Pros & Cons

Unit -V

9

Mobile app analytics - Measure App Success - Counting Installations - Active and New Users - Measure User Engagement - Business Intelligence - Real User Experience –Crashes - Monitor App Performance –Topology- Visual Session Tracking - Instrumentation of a Mobile App - Automated Instrumentation Manual Instrumentation -Capture App Crashes -Build Tool Support

Total: 45 periods

H. Text books:

1. Pedro sostre, Jennifer LeClaire "Web analytics for dummies" Wiley publications, 1st Edition, 2019.(UNIT I to III)
2. Wolfgang Beer, "Mobile App Analytics" O'Reilly Media, Inc. September 2016.(UNIT-IV)
3. Wolfgang Beer, Mobile App Analytics - Optimize Your Apps with User Experience Monitoring, O'Reilly publication, 1st Edition 2016.(UNIT-V)

I. Reference books:

1. Jennifer LeClaire, Vivian Braun "Business analytics in Retail" IBM 2nd Limited edition 2014.
2. Dennis R. Mortensen, "Yahoo Web Analytics" Tracking, reporting, analysing for Data driven insights Wiley Publication, 2009.
3. Brent Chaters, Mastering Search Analytics, O'Reilly publication, 2012.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS188	PREDICTIVE ANALYTICS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will provide an introduction to predictive analytics, exploratory data analysis, and predictive analysis using regression and classification algorithms. This course also helps in building and evaluating the predictive models. The course will primarily use Python programming language.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS114	Data Warehousing and Data mining

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS140	Machine Learning Techniques
2	1152CS172	Deep Learning

D. Course Educational Objectives:

This course helps the students to

- Understand the basic concepts and techniques of Predictive Analytics.
- Develop skills by using python programming language in understanding the various concepts.
- Gain experience in various applications of predictive analytics.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Discuss the Predictive Analytics process model and Exploratory Data analysis	K2
CO2	Understand the concepts of various Regression and	K2

	Classification algorithms	
CO3	Illustrate the various Neural Network models	K2
CO4	Summarize the various ensemble methods and to evaluate the predictive models	K2
CO5	Interpret the various applications of predictive analytics	K2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	H	M							M	M	M			
CO2	H				M					M	M				
CO3				M	M							M			
CO4	M			M						H				M	
CO5			M	M				M	M		H			M	M

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Introduction

9

Introduction – Learning from data – Components of Model - Types of model - Predictive Modeling Process - {HYPERLINK "https://subscription.packtpub.com/book/data/9781789138719/2/ch02lvl1sec18/understanding-the-business-problem-and-proposing-a-solution" \t "blank_"} - Applications – Exploratory Data Analysis - Univariate EDA - {HYPERLINK "https://subscription.packtpub.com/book/data/9781789138719/3/ch03lvl1sec26/bivariate-edu" \t "blank_"} - graphical multivariate EDA .

UNIT II Classifiers

9

Predicting Categories with Machine Learning – Machine Learning – MLR-Lasso Regression – KNN - {HYPERLINK "https://subscription.packtpub.com/book/data/9781789138719/4/ch04lvl1sec36/training-versus-testing-error" \t "blank_"} - {HYPERLINK}

"https://subscription.packtpub.com/book/data/9781789138719/5/ch05lvl1sec42/logistic-regression" \t "blank_"} Regression- Generalized linear models- Logistic Regression – Binary Classifier – Tree based methods – Decision tree – Regression tree – CART – C5.0 - {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/5/ch05lvl1sec44/random-forests" \t "blank_"} {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/5/ch05lvl1sec45/training-versus-testing-error" \t "blank_"} - {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/5/ch05lvl1sec46/multiclassification" \t "blank_"} {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/5/ch05lvl1sec47/naive-bayes-classifiers" \t "blank_"}.

UNIT III Neural Network 9

Neural network models - Stochastic Gradient Descent – Multilayer Perceptron networks – Back propagation Algorithm – Training and Evaluating the networks - {HYPERLINK}

"https://subscription.packtpub.com/book/data/9781789138719/6/ch06lvl1sec52/introducing-tensorflow-and-keras" \t "blank_"} - {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/6/ch06lvl1sec53/regressing-with-neural-networks" \t "blank_"} - Building MLP – Training – Predicting - {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/6/ch06lvl1sec54/classification-with-neural-networks" \t "blank_"}- Evaluating the prediction.

UNIT IV Validation and Tuning 9

Ensemble Methods – Bagging – Boosting - **Model Evaluation**-Evaluation of regression models – Evaluation for classification models-Visualization methods for classification models-{HYPERLINK}

"https://subscription.packtpub.com/book/data/9781789138719/7/ch07lvl1sec61/the-k-fold-cross-validation" \t "blank_"} - {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/7/ch07lvl1sec60/evaluation-for-classification-models" \t "blank_"} - **Model Tuning and Improving Performance** - , {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/8/ch08lvl1sec65/hyperparameter-tuning" \t "blank_"} - {HYPERLINK
"https://subscription.packtpub.com/book/data/9781789138719/8/ch08lvl1sec66/improving-performance" \t "blank_"} .

Recommendation System – Rating matrix- Collaborative filtering – Singular value decomposition – Predicting recommendations- Exploring the data- Building web application using Dash - {HYPERLINK

"<https://subscription.packtpub.com/book/data/9781789138719/9/ch09lvl1sec69/model-communication-and/or-deployment-phase>" \t "blank_"} - Installation of Plotly – building static and Interactive app - {HYPERLINK

"<https://subscription.packtpub.com/book/data/9781789138719/9/ch09lvl1sec71/implementing-a-predictive-model-as-a-web-application>" \t "blank_"}.

H. Learning Resources:

i. Text Books:

1. Alvaro Fuentes, "Hands-On Predictive Analytics with Python", 2nd Edition, 2018
2. James D. Miller, Rui Miguel Forte, "Mastering Predictive Analytics using R", 2nd Edition, 2018

ii. Reference Books:

1. Eric Siegel, "Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die", 3rd edition, Wiley, 2016
2. Anasse Bari, Mohamed Chaouchi, "Predictive Analytics For Dummies", 2nd Edition, John Wiley & Sons Publications, 2017

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS190	TIME SERIES ANALYSIS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will provide an introduction to time series models, study of statistical approaches and their use in various real time applications.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS114	Data Warehousing and Data mining

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Educational Objectives:

Learners will

- Acquaint the concepts of Time Series theory and methods of analysis.
- Understand the differences between cross-sections, time series, and the real time problems, which occur while working with data of these types.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain the type of data used for time series analysis and different types of plotting and visualization techniques used for time series data	K2
CO2	Explain the simulation of time series data and how to store temporal data	K2
CO3	Discuss about the various Time series models	K2
CO4	Explain how to process time series data using Machine and Learning and Deep Learning Techniques.	K2
CO5	Explain how to evaluate the time series data and various applications of Time series data	K2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	H								M	M	M			
CO2		H		M						M	M				
CO3	H											M			
CO4			M	M									M		
CO5			M		M	M				M			M	M	M

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Introduction

9

{HYPERLINK "https://learning.oreilly.com/library/view/practical-time-series/9781492041641/ch01.html" \l "time_series_an_overview_and_a_quick_history"} - Time Series in Diverse Applications - Origin of Time series analysis - Finding and Wrangling Time Series data - Retrofitting a Time Series Data Collection from a Collection of Tables – Constructing found Time Series - **Exploratory Data Analysis for Time Series** – Familiar methods - Understanding and Identifying Self-Correlation – Visualization.

UNIT II Simulating and Storing Temporal data

9

Simulating Time Series Data - Simulation Versus Forecasting - Simulations in Code - A Physics Simulation - Statistical Simulations - Deep Learning Simulations - **Storing Temporal Data** - Defining Requirements -Live Data Versus Stored Data - Database Solutions - SQL Versus NoSQL -Popular Time Series Database and File Solutions- NumPy – Pandas-Standard R Equivalents – Xarray.

UNIT III Stationary and Non Stationary Times Series Model

9

Stationary Time series Model – ARMA model –Spectral Analysis - Modeling and Forecasting with ARMA Processes - Non Stationary Time series Model – ARIMA model - **State Space Models for Time Series** - The Kalman Filter - Hidden Markov Models - Bayesian Structural Time Series - **Generating and Selecting Features for a Time Series** - General Considerations When Computing Features-The Nature of the Time Series-Domain Knowledge-External Considerations.

UNIT IV Machine Learning and Deep Learning for Time Series Data

9

Machine Learning for Time Series - Time Series Classification-Selecting and Generating Features – Decision Tree Methods – Clustering - Generating Features from the Data -

Temporally Aware Distance Metrics - **Deep Learning for Time Series** - Programming a Neural Network - Data, Symbols, Operations, Layers, and Graphs - Training Pipeline- Feed Forward Network- Convolution Model – RNNs.

UNIT V Performance Analysis

9

Measuring Error - The Basics: How to Test Forecasts - Model-Specific Considerations for Backtesting - Estimating Uncertainty - Predicting Multiple Steps Ahead - Recursive Approach to Distant Temporal Horizons - Multitask Learning Applied to Time Series - Model Validation Gotchas - **Performance Considerations in Fitting and Serving Time Series Models** – Time series Applications and Case studies

H. Learning Resources

i. Text Books:

1. Aileen Nielsen, "Practical Time Series Analysis - Prediction with Statistics and Machine Learning", O'Reilly publications, 1st Edition, 2019. (UNIT I,II,IV,V)
2. Peter J. Brockwell Richard A. Davis "Introduction to Time Series and Forecasting", Second Edition, Springer, 2016 (UNIT-III)

ii. Reference Books:

1. Robert H. Shumway, David S. Stoffer, "Time Series Analysis and Its Applications - With R Examples", Third edition, Springer Science+Business Media, 2011
2. William.W.S.Wei, "Time Series Analysis – Univariate and Multivariate Methods" , Second Edition, Pearson, 2006

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS191	DATA VISUALIZATION	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course provides an introduction in data visualization. It helps students in designing principles for creating meaningful displays of quantitative and qualitative data to facilitate managerial decision-making.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS113	Computer Graphics and Image Processing

C. Related Courses:

Sl. No	Course Code	Course Name
1	1156CS701	Major Project

D. Course Educational Objectives:

Learners will have an

- Overview and brief history of the practice of data visualization.
- Exposure on principles and techniques for visualizing data.
- Understanding of the fundamentals of communication and alignment around concepts that are required for effective data presentation.
- Overview and develop an introductory level of competency on the use of several available software tools that can be used for data visualization.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Identify the type of data and able to explain the visualization process	K2
CO2	Illustrate the visualization techniques used for Spatial and Geospatial data	K2
CO3	Discuss the visualization techniques used for Multivariate data and Hierarchical structures.	K2
CO4	Identify the visualization techniques for Text and documents	K2

CO5	Explore different visualization tools for various applications	K2
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F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	H	M								M	M	M		
CO2	H		M	M								M			
CO3						M							M		
CO4	M	M		M							H			M	
CO5			M		M			M	M		H			M	M

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Introduction of Visualization 9

Relationship between Visualization and Other Fields - The Visualization Process - The Scatter plot - The Role of-the User- Types of Data - Structure within and between Records - Data Pre processing - Data Sets - Human Perception and Information Processing – Perception – Physiology- Perceptual Processing - Perception in Visualization- Metrics - Visualization Foundations.

UNIT II Visualization Techniques for Spatial Data and Geospatial Data 9

Visualization Techniques for Spatial Data - One-Dimensional Data - Two-Dimensional Data -Three-Dimensional Data - Dynamic Data. **Visualization Techniques for Geospatial Data** - Visualizing Spatial Data - Visualization of Point Data - Visualization of Line Data - Visualization of Area Data - Issues in Geospatial Data Visualization.

UNIT III Visualization Techniques for Multivariate Data 9

Visualization Techniques for Multivariate Data - Point-Based Techniques - Line-Based Techniques - Region-Based Techniques - Combinations of Techniques - **Visualization Techniques for Trees, Graphs, and Networks** - Displaying Hierarchical Structures - Displaying Arbitrary Graphs/Networks - Issues.

UNIT IV Text and Document Visualization 9

Levels of Text Representations - The Vector Space Model - Single Document Visualizations - Document Collection Visualizations - Extended Text Visualizations - Designing Effective Visualizations - Steps in Designing Visualizations - Problems - Comparing and Evaluating Visualization Techniques.

UNIT V Data Visualization Tools

9

Trends in Data Visualization and Other Tools - Tableau - Data Wrangler, Python, D3.js, R and Shiny - Visualization for Genetic Network Reconstruction - Reconstruction, Visualization and Analysis of Medical Images - Exploratory Graphics of a Financial Dataset - Graphical Data Representation in Bankruptcy Analysis - Visualization Tools for Insurance Risk Processes

H. Learning Resources

i. Text Book

1. Matthew Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization Foundations, Techniques, and Applications", 2nd Edition, A K Peters, Ltd.Natick, Massachusetts, 2015. (UNIT-I-IV)
2. Chun-houh Chen, Wolfgang Hrdle, Antony Unwin, "Handbook of Data Visualization", 2nd Edition, Springer, 2016.(UNIT-V)

ii. Reference Books

1. Donabel Santos, "Tableau 10 Business Intelligence Cookbook", Packt Publishing, 1786465639, 9781786465634, 2016.

iii. Online Resources

1. {HYPERLINK "[https://www.analyticsvidhya.com/blog/2016/10/creating-interactive-data-visualization-using-shiny-app-in-r-with-examples/](https://rstudio.github.io/r2d3/">https://rstudio.github.io/r2d3/"}
2. {HYPERLINK "<a href=)"}
3. {HYPERLINK "<https://medium.com/opex-analytics/when-what-data-viz-part-ii-b4f76f5d0a29>"}
}

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS194	TEXT AND SOCIAL MEDIA ANALYTICS	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will provide an introduction to Text analytics, social media analytics and their use in various real time applications.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1151CS114	Data Warehousing and Data mining

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS140	Machine Learning Techniques
2	1152CS172	Deep Learning

D. Course Educational Objectives:

Learners will

- Acquaint the concepts of Text Data Information and methods of Social Media Analysis
- Understand the differences between Text Data and time social Media, and those real time problems, which occur while working with data of these types.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Explain how to preprocess and vectorize text into high-dimensional feature representations are done	K2
CO2	Discuss how to perform document classification and topic modeling and to steer the model selection process with visual diagnostics	K2
CO3	Illustrate how to extract key phrases, named entities, and graph structures to reason about data in text and build a dialog framework to enable chatbots and language-driven interaction	K2

CO4	Interpret the basic concepts of social network analysis	K2
CO5	Summarize how social media analytics can be used for better strategic decision.	K2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	H	M	M									M	M	
CO2			M										M		
CO3	H				M						M		M		
CO4			M	M							M	M			
CO5					M	M						M		M	

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Introduction to Text Analytics 9

Natural language processing- text processing and wrangling- corpus- corpus- data management- breaking down documents- segmentation- tokenization- tagging- corpus-analytics- corpus- transformation- text vectorization- words in space-time Scimitar Learn API - Transformation pipelines.

UNIT II Classification and Clustering Techniques 9

Classification for text analytics - Text Classification- Classified models-Multinomial Naive Bayes- Logistic Regression- Support Vector Machine-Ensemble models-Random Forest- Evaluating Classification models-Random Building Text Classification Application - Clustering for text similarity- Analyzing text similarity- Analyzing document similarity- Distance metrics- Partition Clustering - Hierarchical Clustering - modeling document topics

UNIT III Feature Extraction and Semantic Analysis 9

Context aware text analysis- Grammer based feature extraction- n- gram feature extraction- n- gram language models- Semantic Analysis- Exploring wordnet- Word Sense Disambiguation- Analyzing Semantic representation- Sentiment Analysis- Text Visualization - Graph Analysis of text - Chatbots- Scaling text analytics with multiprocessing and Spark.

UNIT IV Introduction to Social Media Analytics (SMA) 9

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas
Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods.

UNIT V Social Network Tools 9

Graphs and Matrices- Basic measures for individuals and networks. **Facebook Analytics:** Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes - Tools for Social Network Analysis- UCINET – PAJEK – ETDRAW – StOCNET – Splus – R – NodeXL – SIENA and RSIENA.

H. Learning Resources

i. Text Books:

1. Tony Others, Rebecca Bilbao, Benjamin Bentley, "Applied Text Analysis with Python", O'Reilly publications, 2018
2. Raghav Bali,"Learning Socila Media Analytics with R", Second Editrion ,2017

ii. Reference Books:

1. Dipanjan Sarkar, "Text Analytics with Python - A Practitioner's Guide to Natural Language Processing", 2nd Edition, 2016.
2. Alex Gonclaves , "Social Media Analytics", Third edition, Pearson edition , 2016

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS232	TENSORFLOW FOR DEEP LEARNING	3	0	0	3

Course Category: Program Elective

A. Preamble:

This course will provide an introduction to deep learning, tensor flow primitives and implementation of deep neural network, convolutional and recurrent neural network. It also provides a brief introduction to model deployment.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1154CS106	Data Structures

C. Related Courses:

Sl. No	Course Code	Course Name
1	1152CS124	Soft Computing

D. Course Educational Objectives:

The student will

- Perform basic computation using TensorFlow
- Use TensorFlow for classifications with convolutional neural networks
- Learn how to conduct natural language processing using TensorFlow
- Understand how recurrent neural network work for time series prediction
- Deploy the neural networks to devices using TensorFlow lite

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamentals of deep learning and TensorFlow	K2
CO2	Develop classification and object detection model using convolutional neural networks	K3
CO3	Develop and implement natural language processing applications with TensorFlow	K3
CO4	Implement sequences and time series models using TensorFlow	K3
CO5	Deploy the deep learning models to the devices using TensorFlow lite	K3

F. Correlation of COs with POs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO1	H	M	M								H		M	M	
CO2	H		M										M		M
CO3		M		M	M							L	H		
CO4		M		M								L			
CO5					M						M	L		M	

H- High; M-Medium; L-Low

G. Course Content:

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UNIT I Introduction to TensorFlow for Artificial Intelligence and Deep Learning**9**

Introduction and Building Blocks of Deep Neural Networks - Activation Function and Hyperparameters - Deep Learning Models, Development Platforms and Software Libraries - Linear Regression - Nonlinear and Logistic Regression - Train/Dev/Test Set - Regularization.

UNIT II Convolutional Neural Networks in TensorFlow**9**

Introduction of Convolution Layer - Softmax Function - Pooling Layer and Types - Flatten, Dense and Dropout Layers – Transfer Learning (Alexnet, Resnets, Googlenet, Inceptionnet and Vggnets) - Generative Adversarial Networks - Object Detection - R-CNNs.

UNIT III Natural Language Processing in TensorFlow**9**

Introduction of NLP - Text to Sequence - Word and Character Encodings – Tokenization - Padding - Tensorflow Datasets - CNNs - GRUs - LSTMs - Accuracy and Loss - Work on IMBD Dataset.

UNIT IV Sequences, Time Series and Prediction**9**

Introduction of Sequence Models - Recurrent Neural Network - Different Types of RNNs - Backpropagation - Vanishing Gradients - Bidirectional RNN - Deep RNNs – LSTM on Time Series Data.

UNIT V Device-based Models with TensorFlow Lite**9**

Introduction of Tensorflow Lite - Saving, Converting, and Optimizing Model - Compression - Pruning - Browser-Based Deployment - Android and IOS Deployment - Deployment on Embedded Devices - Advanced Deployment Scenarios.

H. Learning Resources**i. Text Books:**

1. Pramod Singh, Avinash Manure, “Learn TensorFlow 2.0”, Apress, 2020.
2. Armando Fandango, “Mastering TensorFlow 1.x: Advanced machine learning and deep learning concepts using TensorFlow 1.x and Keras”, Packt Publishing, 2018

ii. References:

1. Ian Goodfellow, "Deep Learning", MIT Press, 2016.
2. Reza Bosagh Zadeh, Bharath Ramsundar, "TensorFlow for Deep Learning", O'reilly Publications, 2018.
3. Francois Chollet, "Deep Learning with Python", Manning Shelter Island, 2018.
4. Sam Abrahams, Danijar Hafner, Erik Erwitt, Ariel Scarpinelli, "TensorFlow for Machine Intelligence", Bleeding Edge Press, 2019.
5. <https://www.coursera.org/specializations/tensorflow-in-practice>

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS219	3D Character Modeling	2	0	2	3

Course Category: Program Elective

Course Objective

Modeling process and working with Low poly character model. A strong emphasis is provided to work in efficient modeling, shading, and rendering process. Student can develop a character model for a game design and render time, and how to manage the complex 3d scenes

Course Content:

UNIT I

Introduction to Modeling, 3ds Max Modeling interface, Poly Modeling – Using Primitives – Modeling with Modifiers – Sub division Surfaces, Lattice

UNIT II

Patch Grid – Patch modeling, Compound Objects Modeling – 2D to 3D, 3D to 3D, Introduction to NURBS, Nurbs Splines and Surfaces, Working with Nurbs Curves and Surfaces, Nurbs Curves Modeling, Nurbs Surface Modeling

UNIT III

External References – Objects and Scenes, File Formats, Materials – 2D Maps, 3D Maps, Compositors, Compound Materials – Blend, Composite, Double Sided Materials, Smoothing Polygons, Sub divide Polygons

UNIT IV

Working with poly sub-object, modeling a Low poly Character model for Game Design, Creating Texture for object model, About UVs and Mapping, Material using UVW Mapping, Unwrap Mapping, UVW Mapping, Edit UVW modifier

UNIT V

Setting Biped Animation for character model, Rendering Techniques – Arnold, Art, Scanline – Ray tracer, Radiosity

Software: Autodesk 3ds Max

Learning Resources:

Prof: Sham Tickoo. Autodesk 3ds Max 2019: A Comprehensive guide - CADCAM Technologies, USA

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS221	3D Architecture and Art Design	4	0	4	6

Course Category: Programme Core

Preamble :

Creating 3d landscapes and set or interiors using Autodesk 3Ds max

Includes (3D modeling, texture and lighting)

Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Creating geometry ,Transforms , Modifiers, Animation basics	K2
CO2	Low polygon modeling for games. Props Modeling in game modeling	K3
CO3	Advancement Set Design, Modeling and Texturing and Lighting Considerations and Techniques	K3
CO4	3D lighting system which is used in real life	K3
CO5	Texturing for Architecture model and non organic modeling	K3

Course Syllabus:

UNIT I

Navigating 3D space, Creating geometry ,Transforms , Modifiers, Animation basics, Light and cameras, Material Editor, Materials, and Maps, Rendering , Effects and Environments

UNIT II

Conceptualizing 3D coordinate systems. How to construct 3D models using various tools. Low polygon modeling for games. Props Modeling

UNIT III

Advancement Environment and Set Design, Advancement Modeling and Texturing Environments and Sets, Advancement Lighting Considerations and Techniques

UNIT IV

Tips and tricks for good lighting: Standard sunlight system, faking bounced light, daylight system, angle of incidence, attenuation, exposure control, photometric lights, radiosity, standard lights with scan line rendering, photometric lights with radiosity render, skylight with light tracer rendering, sunlight system, day light system, Skylight. Target spot

UNIT V

Color, Texture and surface styles: The Material Editor, colors and patterns in materials, multiple materials on single objects, lofting the materials, bump mapping, luminance values, maps, mapping coordinates, materials, multi/sub-object materials, procedural maps

Software: Autodesk 3Ds max/ Cinema4d

Learning Resources

i. Text Books:

1. Tickoo, S. (2016). Autodesk 3ds Max 2017: a comprehensive guide. Schererville: CADCIM Technologies.
2. Smith, B. L. (2012). 3ds max design architectural visualization: for intermediate users. Waltham, MA: Focal Press.

COURSE CODE	COURSE TITLE	L	T	P	C
1152CS160	Artificial Intelligence in Fin Tech	3	0	0	3

Course Category: Programme Core

A. Preamble :

Artificial Intelligence is one of the most advanced fields of computer science which involves use of Mathematics, Statistics, Information Technology and Information Sciences in discovering new information and knowledge from large databases and optimize Human effort overall. It is a new emerging interdisciplinary area of research and development which has created interest among scientists of various disciplines like Computer Science, Mathematics, Statistics, and Information Technology.

B. Pre-Requisite courses:

S.No	Subject Code	Subject Name
01	1151CS102	Data Structures

C. Related Courses:

S.No.	Subject Code	Subject Name
01	1152CS124	Soft Computing
02	1152CS110	Knowledge Based Decision Support Systems
03	1152CS139	Artificial Intelligence

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO No.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Summarize Artificial Intelligence and its	K2
CO2	Problem solving using advanced search	K3
CO3	Discuss the Expert Systems and its applications.	K2
CO4	Explain the role of AI in Business Finance.	K2
CO5	Discuss the role of AI in Accounting and	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO1	H										M		
CO2	H	H	H							L	M		
CO3	H	L	M	M					M	L	M	L	
CO4	H	L	M	M		L			M	L	L	M	M
CO5	H	L	H	M		L			M	L	L	M	M

H- High; M-Medium; L-Low

F. Course Content :

UNIT – I Introduction to Artificial Intelligence: 9

Artificial Intelligence - Introduction. Expert systems shells and Products – Business Applications of AI- Turing Test- Branches of AI – Programming for AI – Backward Chaining – Bots and Agents – Fuzzy logic.

UNIT – II Advanced search techniques: 9

State Space Search: Comparison of BFS and DFS- **Randomized Search and Emergent Systems:** Iterated Hill Climbing- Genetic Algorithms- The Travelling Salesman Problem- Emergent Systems- Ant Colony Optimization. **Finding Optimal Paths:** Dijkstra's Algorithm- Algorithm A*- Iterative Deepening A*- Min Max Algorithm – AO*Algorithm.

UNIT – III Expert Systems and Neural Networks 9

Expert Systems – working – ES Tools – Applications of Expert systems – Advantages and Disadvantages of Expert System – Applications – Intelligent Computer Aided Instruction – Business Neural Network Applications- Insolvency Prediction.

UNIT – IV Artificial Intelligence in Business Finance

9

Banking: Granting and Monitoring Credit – Insurance: Underwriting, claims processing and Reserving – Portfolio Management – Advice on Trading – Global Financial Markets- Neural Networks in Business Finance.

UNIT – V Artificial Intelligence in Accounting and Marketing 9

Neural networks in Accounting – securities – Trading Securities – Credit Granting – Detection of Credit Fraud – Inventory Accounting , control and valuation- Payroll control – Budgeting – Auditing.

AI in Marketing: Marketing services – Forecasting – Inventory Management – Trend Analysis – Making decisions in Uncertainty.

Total : 45 Periods

G. Learning Resources :

i. Text books:

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1. "The Artificial Intelligence handbook", Joel Siegel and Jae Shim, Thompson Publishers, 2003.
2. "A First Course in Artificial Intelligence", Deepak Khemani, McGraw Hill Education, 2013.

ii. Reference books:

1. "Logic Foundations of Artificial Intelligence", Michael R. Genesereth, N.J.Nilsson, Morgan Kaufmann Publishers, 1st Ed, 1987.
2. "Artificial intelligence P: A Modern Approach", S.J.Russell et al, PearsonEd India, 3rd Ed, 2015.

iii. Online Reference Links/ Resources:

1. <https://i4iam.files.wordpress.com%2F2013%2F08%2Fartificial-intelligence-by-rich-and-knight.pdf&usg=AOvVaw2A8-1FYIVizB7m-RiVXjhQ>
2. {HYPERLINK "https://nptel.ac.in/courses/109101003" \h}
3. {HYPERLINK "https://nptel.ac.in/courses/109101004" \h}

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ALLIED ELECTIVE

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS101	BASIC COMPUTER SYSTEM ORGANIZATION AND ARCHITECTURE	3	0	0	3

Course Category: Allied Elective

A. Preamble:

This course provides the basics of organizational and architectural issues of a digital computer analyze performance issues in processor and memory design of a digital computer, various data transfer techniques in digital and performance improvement using instruction level parallelism.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Learners are exposed to

- Hardware-software interface.
- Arithmetic and logic unit, fixed point and floating-point arithmetic operations.
- The concept of pipelining.
- Hierarchical memory system including cache memories and virtual memory.
- Different ways of communicating with I/O devices and standard I/O interfaces.\

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's)
CO1	Explain about the basics, instruction set and addressing modes of a computer.	K2
CO2	Familiarize in the arithmetic operations.	K2
CO3	Design and analyze concept of pipeline for consistent execution of instructions with hazards.	K2
CO4	Explain the concepts of Instruction Level parallelism.	K2
CO5	Demonstrate knowledge about state-of-the-art I/O, memory and storage systems	K3

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M												L		
CO2	L	M											M	H	
CO3	M	M		M									L		L M
CO4	M	M		M									L		L L
CO5	M	M												M	

H- Strong; M-Medium; L-Low

G. Course Content:

UNIT I OVERVIEW& INSTRUCTIONS

9

Eight ideas – Components of a computer system – Technology – Performance – Power wall – Uniprocessors to multiprocessors; Instructions – operations and operands – representing instructions –Addressing and addressing modes.

UNIT II ARITHMETIC OPERATIONS

8

ALU - Addition and subtraction – Multiplication – Division – Floating Point operations.

UNIT III PROCESSOR AND CONTROL UNIT

10

Basic MIPS implementation – Building datapath –Pipelining – Pipelined datapath and control – Handling Data hazards & Control hazards – Exceptions.

UNIT IV PARALLELISM

9

Instruction-level-parallelism – Parallel processing challenges – Flynn's classification – Hardware multithreading – Multicore processors.

UNIT V MEMORY AND I/O SYSTEMS

9

Memory hierarchy - Memory technologies – Cache basics –Cache Memory Mapping Techniques– Measuring and improving cache performance - Virtual memory, TLBs, Page Replacement Techniques- Input/output system- DMA and interrupts, I/O processors.

Total: 45 Hours

H. Learning Resources

i.Text Books:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Fourth Edition, Elsevier, 2011.
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Fifth Edition, Tata McGraw Hill, 2002.

Reference Books:

- 1 M.Morris Mano, "Computer System Architecture"- Third Edition, Pearson Education, 2007.
- 2.Behrooz Parhami, "Computer Architecture", Oxford University Press, 2007.
3. V.P. Heuring, H.F. Jordan, "Computer Systems Design and Architecture", Second Edition, Pearson Education, 2004.
- 4, William Stallings, "Computer Organization and Architecture – Designing for Performance", Sixth Edition, Pearson Education, 2003.
5. John P. Hayes, "Computer Architecture and Organization", Third Edition, Tata McGraw Hill, 1998.

iii. Online Resources:

1. www.ComputerArchitectureHome Page
2. ACM Special Interest Group on Computer
3. IEEE Technical Committee on Computer Architecture
4. williamstallings.com/ComputerOrganization/COA8e-Instructor/

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS102	OPERATING SYSTEMS	3	0	0	3

Course Category: Allied Elective

A. Preamble:

In this course will be discussing about Address spaces, system call interface, process/threads, inter process communication, deadlock, scheduling, memory, virtual memory, file systems.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Learners are exposed to

- Overview the components of an operating systems
- The concepts of the process and threads
- Principles of deadlock and related problems of starvations
- Design issues related to processor scheduling
- Thorough knowledge of Process management, Storage management and File Management

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Explain the operating system program, structures and operations with system calls	K2
CO2	Analyze the process management concept for the given situation.	K2
CO3	Apply the concepts of deadlock and get knowledge about CPU scheduling.	K3
CO4	Explain the different storage management for the given	K2

	situation.	
CO5	Explain the mass storage structure and file system Interface.	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L														
CO2	M	H		L								L	M	L	L
CO3	M	H		L								M		L	L
CO4	M	H	M	L								L	M	L	L
CO5	L												L	L	L

H- High; M-Medium; L-Low

G.Course Content:

UNIT I OPERATING SYSTEMS OVERVIEW

9

Operating system overview: Objectives – functions - Computer System Organization- Operating System Structure - Operating System Operations- System Calls, System Programs.

UNIT II PROCESS MANAGEMENT

9

Processes: Process Concept - Process Scheduling - Operations on Processes – Inter process Communication. Process Synchronization: The Critical-Section Problem - Semaphores - Classic Problems of Synchronization – Monitors. Case Study: Windows 10 operating system

UNIT III SCHEDULING AND DEADLOCK MANAGEMENT

9

CPU Scheduling: Scheduling Criteria - Scheduling Algorithms. Deadlocks: Deadlock Characterization - Methods for Handling Deadlocks - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock. Case Study: MAC operating system

UNIT IV STORAGE MANAGEMENT

9

Main Memory: Swapping - Contiguous Memory Allocation, Segmentation, Paging. Virtual Memory: Demand Paging - Page Replacement - Allocation of Frames - Thrashing. Case Study: Android operating system

UNIT V STORAGE STRUCTURE

9

Mass Storage Structure: Disk Structure - Disk Scheduling - Disk Management. File-System Interface: File Concepts, Directory Structure - File Sharing – Protection. File System. Case Study: Linux operating system

Total: 45 Hours

G. Learning Resources

i. Text Books:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2012.
2. Richard Petersen, "Linux: The Complete Reference", 6th Edition, Tata McGraw-Hill, 2008.

ii. Reference Books:

1. Andrew S. Tanenbaum, "Modern Operating Systems", 4th Edition, Prentice Hall, Wesley, 2014.
2. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2011.
3. Harvey M. Deitel, "Operating Systems", 7th Edition, Prentice Hall, 2003.
4. D M Dhamdhere, "Operating Systems: A Concept-Based Approach", 2nd Edition, Tata McGraw-Hill Education, 2007.
5. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education", 1996.

iii. Online Resources:

1. {HYPERLINK "http://www.tutorialspoint.com/operating_system/"}
2. http://www.mu.ac.in/myweb_test/MCA%20study%20material/OS%20-%20PDF.pdf
3. <http://codex.cs.yale.edu/avi/os-book/OS8/os8c/slides-dir/PDF-dir/ch2.pdf>

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS103	OBJECT ORIENTED PROGRAMMING	3	0	0	3

Course Category: Allied Elective

A. Preamble:

To master all techniques of software development in the C++ Programming Language and demonstrate these techniques by the solution of a variety of problems spanning the breadth of the language including C++.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Learners are exposed to

- Understand of the utility of object-oriented programming over procedure-oriented programming.
- Know the concept of code reusability to use third party code in the form of predefined classes to write their programs.
- Use the programs written by others and write the programs that can be used by others without exposing the source code, using package and interface concepts.
- Understand exception handling mechanism for handling exceptional situation that occur during run time.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand and design the solution to a problem using basic object-oriented programming concepts.	K2
CO2	Develop programs or applications using constructor and	K3

	overloading concepts	
CO3	Implement programs using exceptions and file handling for providing programmed solutions to problems	K3
CO4	Demonstrate the use of virtual functions to implement polymorphism and inheritance.	K3
CO5	Implement programs using the features of C++ including templates.	K3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M	L	L									M	
CO2	M	M	L	L	L			L						M	
CO3	M	H	L		M			L		L	L			M	M
CO4	H	M	L	L	L			L						M	
CO5	M	M	L	L	H						L	L		H	L

H- High; M-Medium; L-Low

G. Course Content:

UNIT I

9

Object oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism.

Introduction to C++ – classes – access specifiers – function and data members – default arguments – function overloading – friend functions – const and volatile functions - static members – Objects – pointers and objects – constant objects – nested classes – local classes

UNIT II

9

Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor – destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion – explicit constructors

UNIT III

9

Function and class templates - Exception handling – try-catch-throw paradigm – exception specification – terminate and unexpected functions – Uncaught exception.

UNIT IV

8

Inheritance – public, private, and protected derivations – multiple inheritance - virtual base class – abstract class – composite objects Runtime polymorphism – virtual functions – pure virtual functions

UNIT V

10

RTTI – typeid – dynamic casting – RTTI and templates – cross casting – down casting. Streams and formatted I/O – I/O manipulators - file handling – random access – object serialization – namespaces - std namespace – ANSI String Objects – standard template library.

Total: 45 Hours

H. Learning Resources

i. Text Books:

1. B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

ii. Reference Books

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Second Edition Reprint 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Fourth Edition, Pearson Education, 2005.
- 3.B. Stroustrup, "The C++ Programming language", Third edition, Pearson Education, 2004

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS104	DATA STRUCTURES USING C	3	0	0	3

Course Category: Allied Elective

A. Preamble:

This course introduces the basic concepts and techniques of Linear and nonlinear data Structures and Analyze the various algorithm.

Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

B. Related Courses:

Sl. No	Course Code	Course Name
		Nil

C. Course Educational Objectives:

Learners are exposed to

- Be exposed to the concepts of ADTs
- Learn linear data structures – list, stack, and queue.
- Learn non-linear data structures – Tree, graph etc
- Be exposed to sorting, searching, hashing algorithms

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the user defined data types and the representation of linear data structures for solving real world problems.	K2
CO2	Implement the concepts of self-balancing Binary Search Trees for solving the real world scenarios.	K3
CO3	Describe the hash function concepts of collision and its resolution methods	K2
CO4	Compute the complexity of various algorithms to solve the problem by involving graphs and trees	K3
CO5	Apply Algorithm for solving problems by using sorting, searching, insertion and deletion of data	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	M	L		L								L	H	
CO2	M	M	L		L								L	L	
CO3	M	M			L								M	L	
CO4	M	H	L	M	L							L	L	H	L
CO5	M	M	L	M	L								L	H	L

H- High; M-Medium; L-Low

F. Course Content:

UNIT I LINEAR DATA STRUCTURE	9
Introduction - Time and space complexity analysis - Abstract Data Type (ADT) – The List ADT – Array Implementation – Linked List Implementation– The Stack ADT – The Queue ADT – Applications of Stack, Queue and List.	
UNIT II TREES	9
Introduction to trees - Tree Traversal - Binary Trees - Definitions – Expression Tree – Binary Tree Traversals - The Search Tree ADT – Binary Search Trees - AVL Tree.	
UNIT III SPECIAL TREES & HASHING	9
Splay Tree – B-Tree - Priority Queue - Binary Heap -.Hashing - Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing – Rehashing.	
UNIT IV GRAPH	9
Introduction to Graphs - Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths –Dijkstra’s Algorithm – Minimum Spanning Tree – Prim’s Algorithm- Kruskal’s Algorithm – Breadth first search – Depth-First Search – Undirected Graphs – Biconnectivity.	
UNIT V SORTING & SEARCHING	9
Sorting algorithm- Insertion sort- Selection sort- Shell sort-Bubble sort- Quick sort- Heap Sort-Merge sort- Radix sort - Searching – Linear search - Binary search.	

Total: 45 Hours

G. Learning Resources

i. Text Books:

{PAGE }

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Second Edition, Pearson Education, 2007.

ii. Reference:

1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition Reprint 2003.
2. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2005.
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structure", Computer Science Press, 1995.

iii. Online resources

1. <http://simplenotions.wordpress.com/2009/05/13/java-standard-data-structures-big-o-notation/>
2. <http://mathworld.wolfram.com/DataStructure.html/>.

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS105	WEB DESIGNING	3	0	0	3

Course Category: Allied Elective**A. Preamble:**

This course Internet Programming provides an introduction and Basic Concepts of Server-Side Programming and Designing of Static and Dynamic Webpages.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Link to Other Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objective:

Students are exposed to:

- Basic Internet Protocols.
- JAVA and HTML tools for Internet programming.
- Scripting languages – Java Script.
- Dynamic HTML programming and Web services
- Server-Side Programming tools

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos .	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand the concepts of appropriate database Connectivity of Java and SQL for a web Application	K2
CO2	Illustrate various services in Hibernate and Struts framework	K2
CO3	Design a static web page using HTML for the given Application	K3
CO4	Design and implement simple web page in PHP, and to present data in XML format.	K3
CO5	Design rich client presentation using AJAX.	K3

F. Correlation of COs with Programme outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	H	H	L											M	
CO2	M													M	
CO3	H	H	H		L	M			L					M	L
CO4	H	H	H		M	M			L					M	L
CO5	H	H	M		M	M			L					M	L

G.Syllabus Content:

UNIT I WEBSITES BASICS, HTML 5, CSS 3

9

Basics-RIA Rich Internet Applications Internet technologies Overview –Understanding the difference between internet and intranet; HTML and CSS: HTML 5.0, XHTML, CSS 3- TCP and Datagram Sockets – Remote Method Invocation - Servlets, Java Server Pages. – JDBC Java Beans – Enterprise Java Beans.

UNIT II NAMING SERVICES AND STRUTS

9

Java Security – Native Methods – Java Virtual Machine - Naming Services – Java Mail – Java Messaging Services – Transactions- Introduction to struts Frame work.

UNIT III HIBERNATE, HTML AND PROTOCOLS

9

Introduction to hibernate – Hibernate, HQL – J2EE (struts) and hibernate –Hibernate and Aspect – Birth Reporting Tool. Introduction – Network concepts - Web concepts – Internet addresses – URL – Retrieving Data with URL - CGI – Introduction to HTML – HTML protocols – HTTP, SMTP, POP3, MIME, IMAP – Forms – Events

UNIT IV PHP and XML 8

9

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in Functions-Connecting to Database – Using Cookies-Regular Expressions; XML: Basic XML- Document Type DefinitionXML Schema DOM and Presenting XML, XML Parsers and Validation, XSL and XSLT Transformation, News Feed (RSS and ATOM).

UNIT V INTRODUCTION TO AJAX and WEB SERVICES

9

Ajax Client Server Architecture-XML Http Request Object-Call Back Methods; Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application – SOAP

Total: 45 Hours

G. Learning Resources:

i. Text Books

{PAGE }

1. Deitel & Deitel, Goldberg, "Internet and world wide web – How to Program", Pearson Education Asia, 2011.

ii. Reference Books

1. Chris Bates, Web Programming – Building Intranet Applications, 3 rd Edition, Wiley Publications, 2009.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2011.
3. Uttam K.Roy, "Web Technologies", Oxford University Press, 2011.

iii. Online Resources

1. Eric Ladd, Jim O' Donnel, "Using HTML 4, XML and JAVA", Prentice Hall of India – QUE, 1999.
2. PHP & MYSQL TimConverse,Joyce Park, Alark Morgan.
3. PHP for Beginners Vikram Vaswani, Tata McGraw-Hill
4. Ajax in Action, Dreamtech press
5. WWW. W3schools.com

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS106	CLOUD COMPUTING	3	0	0	3

Course Category: Allied Elective

A. Preamble:

Cloud computing is an emerging computing paradigm where various users access the resources and services offered by service providers. Use of cloud computing at this course encompasses the production services and it can offer benefits in the cost, performance, and delivery of IT services. The use of cloud computing services is forecast to grow significantly over the coming years.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
		Nil

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Students undergoing this course are expected to gain:

- To access resources and services needed to perform functions with dynamically changing needs.
- To understand the cloud privacy and security concepts to create secure cloud environment.
- To learn the various cloud platforms to implement real time cloud applications.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the fundamental concepts of Cloud computing components and architecture.	K2
CO2	Discuss the technology and tool kits to facilitate the Cloud computing	K2
CO3	Analyze the cloud computing security issues	K2
CO4	Identify the issues in resource optimization for cloud computing environment	K3
CO5	Demonstrate the installation of cloud platform and	K3

	evaluate the performance.	
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F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M			L								L			
CO2	M	L	L	M	M								H	L	
CO3	M	L		M					M						
CO4	M	M		M	M	M			L				L		L
CO5	M	L		M	H								H		

G. Course Content:

UNIT I Introduction to Cloud Computing

L-9

Definition, Characteristics, Components, Cloud provider, SAAS, PAAS, IAAS and Others, Organizational scenarios of clouds, Administering& Monitoring cloud services, benefits and limitations, Deploy application over cloud, Comparison among SAAS, PAAS, IAAS Cloud computing platforms: Infrastructure as service: Amazon EC2,Platform as Service: Google App Engine, Microsoft Azure, Utility Computing, Elastic Computing.

UNIT II Introduction to Cloud Technologies

L-9

Study of Hypervisors Compare SOAP and REST Web services, AJAX and mashups-Web services: SOAP and REST, SOAP versus REST, AJAX: asynchronous 'rich' interfaces, Mashups: user interface services Virtualization Technology: Virtual machine technology, virtualization applications in enterprises, Pitfalls of virtualization Multitenant software: Multi-entity support, Multi-schema approach, Multitenancy using cloud data stores, Data access control for enterprise applications.

UNIT III Cloud security fundamentals

L-9

Vulnerability assessment tool for cloud, Privacy and Security in Cloud computing security architecture: Architectural Considerations- General Issues, Trusted Cloud computing, Secure Execution Environments and Communications, Micro-architectures; Identity Management and Access control Identity management, Access control, Autonomic Security Cloud computing security challenges: Virtualization security management virtual threats, VM Security Recommendations, VM-Specific Security techniques, Secure Execution Environments and Communications in cloud.

UNIT IV Issues in cloud computing

L-9

Implementing real time application over cloud platform Issues in Intercloud environments, QOS Issues in Cloud, Dependability, data migration, streaming in Cloud. Quality of Service

(QoS) monitoring in a Cloud computing environment. Cloud Middleware. Mobile Cloud Computing. Inter Cloud issues. A grid of clouds, Sky computing, load balancing, resource optimization, resource dynamic reconfiguration, Monitoring in Cloud.

UNIT V Cloud computing platforms

L-9

Installing cloud platforms and performance evaluation Features and functions of cloud platforms: Xen Cloud Platform, Eucalyptus, OpenNebula, Nimbus, TPlatform, Apache Virtual Computing Lab (VCL), Enomaly Elastic Computing Platform

Total: 45 Hours

h. Learning Resources

i. Text Books

1. Antohy T Velte, et.al," Cloud Computing: A Practical Approach", McGraw Hill, 2009
2. Gautam Shroff, Enterprise Cloud Computing- Technology, Architecture and Applications, Cambridge University Press, 2010.
3. Barrie Sosinsky, "Cloud Computing Bible",Wiley India, 2011.

ii. Reference Books

1. Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper , "Cloud Computing for Dummies",Wiley India Edition 2009.
2. Ronald Krutz and Russell Dean Vines, "Cloud Security", Wiley – India, 2010.
3. Tim Malhar, S.Kumaraswamy, S.Latif , "Cloud Security & Privacy", SPD, O'REILLY, 2009

Course Category: Allied Elective

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS107	E COMMERCE	3	0	0	3

A. Preamble:

The extensive penetration of computer networks, in particular the Internet, into everyday life has changed the way business is conducted and is now changing the way commerce is conducted. The development of the World Wide Web (WWW) has made access to information easy for the common user. It is now commonplace for businesses to have a "Web presence" in terms of providing product information and customer service. Some amount of commerce activity has already started on the Internet and expectations are high that it will become a major form of trade and commerce in the future. This major project focuses on electronic commerce (EC) and the infrastructure necessary to implement an Internet-based version of this application.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
		Nil

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Students undergoing this course are expected to

- Nurture Qualified Human Capital
- Cater the demand for "a potentially huge captured market of "E-Commerce and Business" program.
- Foster Competent and Qualified Professionals in E-Commerce
- Utilize fundamental strength in hard and soft skills.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the role of E commerce and its uses	K2
CO2	Summarize the infrastructure for E commerce	K2
CO3	Analyze the various tools and software used for E commerce	K2
CO4	Understand the different security and marketing strategies in E commerce	K2
CO5	Understand the web based design and its applications	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M								L						M
CO2	M			M											
CO3	M	L	M	M										M	M
CO4	L	L							L						M
CO5	L	L			M	L			L						M

H- High; M-Medium; L-Low

G. Course Content:**UNIT I INTRODUCTION** 9

Traditional commerce and E commerce – Internet and WWW – role of WWW – value chains – strategic business and Industry value chains – role of E commerce.

UNIT II INFRASTRUCTURE FOR E COMMERCE 9

Packet switched networks – TCP/IP protocol script – Internet utility programmes – SGML, HTML and XML – web client and servers – Web client/server architecture – intranet and extranets.

UNIT III WEB BASED TOOLS FOR E COMMERCE 9

Web server – performance evaluation - web server software feature sets – web server software and tools – web protocol – search engines – intelligent agents –EC software – web hosting – cost analysis.

UNIT IV SECURITY **9**

Computer security classification – copy right and Intellectual property – electronic commerce threats – protecting client computers – electronic payment systems – electronic cash – strategies for marketing – sales and promotion – cryptography – authentication.

UNIT V INTELLIGENT AGENTS **9**

Definition and capabilities – limitation of agents – security – web-based marketing – search engines and Directory registration – online advertisements – Portables and info mechanics – website design issues.

Total: 45 Hours

H. Learning Resources

i. Text Books

1. Ravi Kalakota, "Electronic Commerce", Pearson Education,
2. Gary P Schneider "Electronic commerce", Thomson learning & James T Peny Cambridge USA, 2001.
3. Manlyn Greenstein and Miklos "Electronic commerce" McGraw-Hill, 2002.

ii. REFERENCES

1. Efraim TurvanJ.Lee, David kug and chung, "Electronic commerce" Pearson Education Asia 2001.
2. Brenda Kienew E commerce Business Prentice Hall, 2001.

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS108	PROGRAMMING IN JAVA	3	0	0	3

Course Category: Allied Elective

A. Preamble:

Most of the software need to develop runs in cross platform. Java is the one of the pioneer software development tools developed used for cross platform development software. From the system towards the handheld devices all place Java become one of the most dominant software. This course provides a basic concept about Object Oriented Programming, Database connectivity, Networking and finally provides programming skills in java. After successful completion of this course learners can able to develop software modules for real world problem.

B. Pre-requisites:

Sl No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl No	Course Code	Course Name
		NIL

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand basic in Java Programming.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
- Familiarize in important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Use the Java SDK environment to create, debug and run simple Java programs.

E. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Design and implement basic data types and control flow constructs using J2SE or other Integrated Development Environments.	K2
CO2	Write, compile and execute Java programs using object-oriented class structures with parameters, constructors, and utility and calculations methods, including inheritance, test classes and exception handling.	K3
CO3	Demonstrate multitasking using Threads.	K3
CO4	Develop simple applications using GUIs and event driven programming	K3
CO5	Develop applets for inclusion in web pages; applets to access enterprise data bases in robust, enterprise applications	K3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M												M	L	
CO2	M		M	M										M	
CO3	M							M	L				M		M
CO4	M		M	L	M			M	L				L	L	L
CO5	M		M	M	M			M					L		

H- High; M-Medium; L-Low

G. Course content:

UNIT I INTRODUCTION TO JAVA

9

Basic concepts of object-oriented programming and Benefits of OOP – Instruction about Simple java program- fundamentals- Class fundamentals - constructors - this keyword - garbage Collection and finalize () - Arrays & Strings - Functions – Command line Arguments.

UNIT II INHERITANCE AND PACKAGE	9
Basic concept of Inheritance: Polymorphism - Making methods and classes final - Abstract classes and methods – Interfaces. Package: Introduction about package-package creation and package access.	

UNIT III THE EXCEPTION AND THREADS	9
Exception:Exception Types - Uncaught Exceptions - Using Try Catch - Multiple Catch - Nested try and throw – Throws – finally - Built in Exceptions - Using Exceptions. Multithreaded Programming: Thread model –Creating a thread - Creating multiple thread –Thread Priority – Thread Scheduling – Thread Synchronization.	

UNIT IV APPLET AND AWT COMPONENTS	9
Applet: Introduction of Applet – Life cycle of Applet – Passing parameters to applet AWT: AWT classes – Event Model – Swing classes	

UNIT V DATABASE CONNECTIVITY AND NETWORK BASICS	9
Introduction of JDBC: JDBC Drivers – Database connection – Getting Data from a table Java and Net: InetAddress – URL Connection - TCP/IP Client socket –TCP/IP Server socket – Datagrams.	

Total: 45 Hours

H. Learning Resources

i. TEXT BOOK

1. PatricNaughton , Herbert Schildt, *The Complete Reference "Java 2"*, Third edition Tata Mc Graw Hills ,1999.

ii. REFERENCE BOOKS

1. H.M.Deitel and P.J.Deitel –“**Java How to Program**” Pearson Prentice Hall Sixth Edition, 2009.
2. E. Balaguruswamy,*Programming in java* , Second Edition,TMH,1999.
3. Graham Hamilton, Rick Cattell, Maydene Fisher ,”*JDBC Database access with java*”- 1997
4. Bruce Eckel – “**Thinking in Java**” Pearson Prentice Hall Third Edition-2006

iii. WEB REFERENCES

1. docs.oracle.com/javaee/6/tutorial/doc/girgm.html
2. www.webreference.com/programming/java.html

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS109	GREEN COMPUTING	3	0	0	3

Course Category: Allied Elective

A. Preamble :

Student must know about basic energy management option in individual components such as CPUs, network interfaces, hard drives, memory and operating systems.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem solving using C

C. Course Educational Objectives :

Upon completion of the course, students should be able to:

- give an account of the concept green IT,
- give an account of environmental perspectives on IT use,
- give an account of standards and certifications related to sustainable IT products,
- describe green IT in relation to technology,
- relate green IT to sustainable development,
- evaluate IT use in relation to environmental perspectives,
- discuss how the choice of hardware and software can facilitate a more sustainable operation,
- use methods and tools to measure energy consumption

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO No's	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	To understand the concepts of technologies that conform to low-power computation	K2
CO2	To understand green (power-efficient) technologies for components of one single computer, such as CPU, memory and disk, and appreciate cutting edge designs for these components	K2
CO3	To have a basic understanding of a variety of technologies applied in building a green system and to identify the various key sustainability and green IT trends	K2
CO4	To discuss the various laws, standards and protocols for	K2

	regulating green IT	
CO5	Be able to use a range of tools to help monitor and design green systems	K3

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M					M	M								
CO2	M					M	H								
CO3	M					M	H							M	
CO4	M					H	H							M	H
CO5	M					H	H						L	M	H

H- High; M-Medium; L-Low

F. Course Content:

UNIT I Fundamentals 9

Green IT Fundamentals: Business, IT, and the Environment –Green computing: carbon foot print, scoop on power –Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

UNIT II Green Assets and Modeling 9

Green Assets: Buildings, Data Centers, Networks, and Devices - Green Business Process Management: Modeling, Optimization, and Collaboration –Green Enterprise Architecture –Environmental Intelligence Green Supply Chains –Green Information Systems: Design and Development Models.

UNIT III Green Framework 9

Virtualizing of IT systems –Role of electric utilities, Telecommuting, teleconferencing and teleporting –Materials recycling –Best ways for Green PC –Green Data center – Green Grid framework.

UNIT IV Green Compliance 9

Socio-cultural aspects of Green IT –Green Enterprise Transformation Roadmap –Green Compliance: Protocols, Standards, and Audits –Emergent Carbon Issues: Technologies and Future.

UNIT V Case Studies 9

The Environmentally Responsible Business Strategies (ERBS) –Case Study Scenarios for Trial Runs – calculating the carbon footprint – greening mobile devices - CASE STUDIES –Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

TOTAL: 45

G. Learning Resources

i. Text Books

3. Bhuvan Unhelkar, Green IT Strategies and Applications-Using Environmental Intelligence, CRC Press, June 2011
4. Woody Leonhard, Katherrine Murray, Green Home computing for dummies, August 2009.

ii. Reference Books:

6. Alin Gales, Michael Schaefer, Mike Ebbers, Green Data Center: steps for the Journey, Shoff/IBM rebook, 2011.
7. John Lamb, The Greening of IT, Pearson Education, 2009.
8. Jason Harris, Green Computing and Green IT-Best Practices on regulations & industry, Lulu.com, 2008.
9. Carl Speshocky, Empowering Green Initiatives with IT, John Wiley & Sons, 2010.
10. Wu Chun Feng (editor), Green computing: Large Scale energy efficiency, CRC Press, 2012

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS110	FUNDAMENTALS OF IOT	3	0	0	3

Course Category: Allied Elective

A. Preamble :

The core modules of this elective course include introduction to IoT, Elements of IoT, Data Analytics and IoT Platform. This course aims to teach the student to understand the concepts of Internet of Things(IoT) and its applications.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the concepts of Internet of Things.	K2
CO2	Explain the fundamentals and protocols in IoT	K2
CO3	Understand the basics of industrial IoT and clustering	K2
CO4	Explain the IoT concepts of Big data and cloud computing.	K2
CO5	Express the knowledge about Arduino and Raspberry Pi.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M														
CO2	M	L												L	
CO3	M	L			L									L	

CO4	M				L									L	
CO5	M	L		M	L				M	L	L	L		L	

H-High M-Medium L-Low

F. Course Content :

Unit I Introduction 9

Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT – IoT Architecture - and Core IoT Functional Stack.

Unit II Fundamentals and Protocols: 9

Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication. Basic of Networking – Communication protocols – M2M and WSN Protocols- Supervisory Control and Data Acquisition and RFID Protocols, CoAP and MQTT.

Unit III Industrial IoT and Clustering 9

Cybersecurity in Industry 4.0 - Industrial IoT- Layers – Network Layers, IEEE 802.15.4, ZigBee Architecture. Clustering – Role of Machine language - Software Agents - Software Agents for Object

Unit IV Big Data and Cloud Computing concepts in IoT 9

Big Data Analytics and Software Defined Networks- No SQL Databases - Data Management with Hadoop - Security and Fog Computing - Cloud Computing - Cloud Standards -Cloud of Things Architecture - Open Source e-Health sensor platform.

Unit V Implementation and its Applications 9

Introduction to Arduino Programming – Installation of Arduino (IDE) – Getting started with Circuits – Components used in circuits – Fritzing for circuit design - IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming - Integration of Sensors and Actuators with Arduino.

G. Learning Resources

i. Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grosssetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Michael Margolis, "Arduino Cookbook" O'Reilly, Second Edition, 2011.

ii. References

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

iii. Online Resources

1. <https://www.arduino.cc>
2. <http://www.theinternetofthings.eu/what-is-the-internet-of-things>

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS301	PYTHON PROGRAMMING LAB	0	0	4	2

Course Category: Allied Elective

A. Preamble:

This course focuses on developing the python programming to do a variety of programming tasks where the students are encouraged to develop application using pygame. At the end of the course the student will be developing adequate skills in programming and will be known to understand the implementation of various applications using python.

B. Pre-requisite:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		NIL

D. Course Outcomes

At the end of the course, the students are able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Write, Test and Debug Python Programs	K3, S3
CO2	Implement Conditionals and Loops for Python Programs	K3, S3
CO3	Use functions and represent Compound data using Lists, Tuples and Dictionaries	K3, S3
CO4	Read and write data from & to files in Python and develop Application using Pygame	K3, S3

K3-Apply, S3-Processes

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	H			H				L				L	M	
CO2	M	H			H				L					M	
CO3	M	H			H				L						M
CO4	H	H	H		H				H		H			H	H

F. Course Content

LIST OF EXPERIMENTS

1. Running instructions in Interactive interpreter and a Python Script.
2. Write a program to purposefully raise Indentation Error and correct it.
3. Scientific problem solving using decision making and looping.
4. Simple programming for one dimensional and two dimensional arrays.
5. Python Programming to explore string functions.
6. Utilizing 'Functions' in Python
 - Find mean, median, mode for the given set of numbers in a list.
 - Write a function dups to find all duplicates in the list.
 - Write a function unique to find all the unique elements of a list.
 - Write function to compute gcd, lcm of two numbers
7. Demonstrate the use of Lists, Dictionaries.
8. Write a program to implement Turtle.
9. Building a Classical Data Structure using Python Programming.
10. Implement Searching Operations: Linear and Binary Search.
11. To sort the 'n' numbers using: Selection and Insertion Sort.
12. Find the most frequent words in a text read from a file.
13. Demonstrate Exceptions in Python.
14. Simulate elliptical orbits and bouncing ball using Pygame

F. Learning Resources:

i. Reference Books:

1. Allen B. Downey , " Think Python: How to Think Like a Computer Scientist", Second Edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016.

2. Shroff "Learning Python: Powerful Object-Oriented Programming; Fifth edition, 2013.
3. David M.Baezly "Python Essential Reference". Addison-Wesley Professional; Fourth edition, 2009.
4. David M. Baezly "Python Cookbook" O'Reilly Media; Third edition (June 1, 2013) by.
5. <http://www.edx.org>

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS201	OBJECT ORIENTED PARADIGMS FOR PRODUCT DEVELOPMENT	4	0	4	6

Course Category: Allied Elective

A. Preamble:

Most of the software needs to develop an application which runs in cross platform. Java is the one of the pioneer software tool used to cross platform development software. Also Java is the most dominant software to develop internet applications , distributed web applications and mobile android applications and etc... This course provides Java Basics, Object Oriented Programming, Packages, Exceptions, Networking, AWT, Swing, JDBC, J2EE, Case study of mini applications and gaming tool. After successful completion of this course learners can able to develop software modules for real world problem.

B. Pre-requisites:

S1 No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

S1 No	Course Code	Course Name
1	1154CS104	Android Mobile Application Development
2	1153CS108	Programming in JAVA

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Describe the concepts of Object Oriented Programming (OOP) techniques and to familiarize the Java fundamentals.	K2
CO2	Explain the concepts of java packages, inheritance and exception handling mechanisms.	K2

CO3	Develop and Demonstrate the programs in I/O Streams, String and Collection.	K3
CO4	Develop the programs in AWT, Swing, Thread and Networking.	K3
CO5	Demonstrate J2EE Components and develop the applications.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	L				L			M	L	L			L		L
CO2	L				L			H	L	L	L		L	M	L
CO3	L	L	M		L			H	M	L	M		L	M	L
CO4	L	L	L		M			H	M	L	M		L	M	L
CO5	L	M	M	M	H			H	H	M	H	M	L	M	M

H- High; M-Medium; L-Low

F. Course Content

UNIT-I

BASICS OF JAVA

12

Introduction to Java Technology- Origin of Java - Object-oriented programming – Features of Java – JDK - JVM - Keywords - Data types and Variables – Literals - Operators and Expressions - Control structures - Classes and Objects – Fields and Methods – Encapsulation- Access Control- Access Specifiers and Modifiers – printf format strings- Constructors -Type Casting – this Keyword - Inner classes- static nested classes - Static - Arrays.

UNIT-II PACKAGE, INHERITANCE, POLYMORPHISM AND EXCEPTION HANDLING

12

Java API Packages - Package Access- Basics of Inheritance - Forms of Inheritance - Super keyword – Final - Abstract Classes – Interfaces- Method Overloading - Method Overriding- Exception overview- Exception Hierarchy – Exception Types - Exception handling strategies- Exception keywords- User defined exception

UNIT-III I/O STREAMS, STRING AND COLLECTION

12

File- I/O Stream- Character Streams – Byte Streams - Object Serialization – Serialization API and interface, String – String Buffer - String handling mechanisms- Collection overview - Collection Frameworks Hierarchy – Interface and Implementation classes: Set- List- Map- Generic Classes and Methods.

UNIT-IV APPLET, AWT, SWING, THREAD AND NETWORKING 12

Applets: Basics of applets - Applet Architecture - Life cycle of an Applet – GUI programming with AWT- Delegation event Model - Event Handling. Swing overview- Swing Components-Thread - Thread Creation - Thread priority - Thread operations - Thread states – Thread Groups - Thread Synchronization – Multithreading. Basics of Java Networking- Networking API.

UNIT-V ADVANCED JAVA PROGRAMMING (J2EE) 12

Introduction and overview of Database Basics- SQL, MYSQL – JDBC API: JDBC Architecture - JDBC Drivers- Database connectivity in Java- java.sql methods and interfaces, Overview of J2EE- Servlets: Servlet Architecture - Life cycle of a Servlet - The Servlet API- Cookies - Session Tracking mechanisms- JSP: Overview- Life cycle of JSP- JSP directives –JSP objects – custom tags, Overview of EJB.

Case study: Developing Mini Applications - University management system, House Management System, Weather forecasting system, Candidate management system, Student assessment system.

Case study: Java gaming tool: GreenFoot

TOTAL: 60

G. Learning Resources

i. Text Books

1. **Herbert Schildt, "Java the Complete Reference"**, Ninth edition, Tata Mc-Graw Hill ,2014.
2. **Cay S. Horstman and Gary Cornell, "Java: Core Java 2 Vol. 1: Fundamentals"**, Sun

Microsystems Press, Seventh Edition.

ii. Reference Books

1. H.M. Deitel and P.J. Deitel," Java How to Program", Pearson Prentice Hall Seventh Edition.
2. E. Balaguruswamy, "Programming in java", Fourth Edition, Tata McGraw Hill,2010
3. Jason Hunter, William Crawford," Java Servlet Programming", Second Edition, O'Reilly
4. Kathy Sierra, Bert Bates: "Head First Java- A Learners Guide", Second Edition, O'Reilly
5. Kathy Sierra, Bert Bates , "SCJP- Sun certified programmer for Java 6 study Guide", Tata Mcgraw Hill.

iii. Digital Resources

1. <http://www.w3schools.com/>
2. <https://www.javatpoint.com/>
3. <https://www.tutorialspoint.com/java/>
4. <https://www.sanfoundry.com/java-questions-answers-freshers-experienced/>
5. <https://www.greenfoot.org/>
6. <http://codingbat.com/java/>

COURSE CODE	COURSE TITLE	L	T	P	C
1153CS202	WEB DESIGN FOR IOT	4	0	4	6

Course Category: Allied Elective

A. Preamble:

This course Open Source Web Development will provides detailed knowledge to develop a web site (static and dynamic) with multiple client and server communication using regular HTML, XHTML, XML, CSS, Java Script, SQL and PHP. In the way of complete open source web development, this course will also provide you with the detailed knowledge in Databases like MySql, MongoDb (No Sql DB), Predefined CSS like W3.CSS, Data transferring technique like JSON, No

Sql compatible server side scripting like Node.js and IOT based web server communication with Raspberry Pi.

B. Pre-requisites:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Link to Other Courses:

Sl. No	Course Code	Course Name
1	1153CS105	Web Design

D. Course Educational Objective:

Students are exposed to:

- Client Side Scripting: HTML, XHTML, XML, DTD, CSS, W3.CSS, Java Script, JQuery
- Server Side Scripting: PHP, Node.js
- IOT Based Server: Raspberry Pi
- SQL Database: My Sql
- No SQL Database: MongoDB
- Data Transferring Technique: JSON, JSONP

E. Course Outcomes:

Upon the successful completion of the course, learners will be able to

CO Nos .	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Construct the HTML, XHTML and XML Documents	K3
CO2	Build Responsive Web Pages.	K3
CO3	Build Dynamic Web Pages.	K3
CO4	Develop a complete web application with database connectivity.	K3
CO5	Develop a IOT based web application.	K3

F. Correlation of COs with Programme outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L		L		L				L				L	M	M
CO2	L		M		L	L			L				L	M	M

CO3	L		M		M	M			M			L		H	H
CO4	M	L	H	L	M	H	L	L	H	L		M	L	H	H
CO5	M	M	H	M	H	H	M	L	H	M		H	M	H	H

H- High, M-Medium and L-Low

G. Syllabus Content: **L – 60,**
P - 60

Unit I – Web Introduction, HTML 5, XHTML, XML **L - 10, P - 10**

History of Browsers and it's Support – Client Server Model - HTML Documents – HTML Comments – Basic HTML Elements& Attributes:Paragraph, Heading, Table, List, Buttons Images, Links, Drop Downs, Formatting Tags – HTML Blocks - HTML IFrames – HTML Forms: HTML Form Elements, Input Type, Input Attribute – HTML 5 New Elements – XHTML – HTML Media: Audio, Video, Plug-ins, YouTube - XML Introduction – XML Elements and Attributes – XML DTD.

Unit II – Responsive Web Page Creation **L -12,**
P -12

CSS Introduction – Syntax –Ways to Insert CSS – Selectors –CSS Combinators - CSS Box Model – CSS Styles: Position, Float, Background, Borders, Margin, Padding, Height/Width, Outline, Text, Font, Links, List, Tables, Display, Overflow, Opacity, Round Corners, Shadows.

W3.CSS Introduction – Color – Containers – Panels – Borders – Cards – Fonts – Test – Round – Padding – Margins – Display – Buttons – Notes – Quotes – Alerts – Tables – List – Images – Input – Badges – Tags – Layout – Animations –Effects – Bars – Dropdowns – Accordions – Navigation – Sidebar – Tabs – Pagination – Progress Bar – Slidshow – Modal – Tooltips.

Unit III – Dynamic Web Page Creation **L – 12, P - 12**

Java Script Introduction – Where to Use – Display Possibilities –Statements and Syntax – Comments – Data Types – Variables – JS Type Conversion - Operators – JS Conditions – JS Loops - Functions – Objects – Events – String Methods and Properties – Number Methods and Properties – JS Arrays – Array Methods – Array Sort – JS Dates – JS Math – JS Random – JS Forms – JS Form API's –JS HTML DOM – JS Browser BOM: JS

Window, JS Screen, JS History, JS Navigator, JS Location, JS Pop Alert, JS Timing, JS Cookies.

JSON Introduction –Syntax – JSON Vs XML – JSON Data Types – JSON Parse – JSON Stringify–JSON Objects – JSON Arrays – JSON HTML – JSONP

W3.JS Introduction – Selectors – Hide/Show – Add Style – Add Class – Sort – Slide Show – Includes – Http.

Unit IV – Web Page Server Side Scripting and Database Interaction **L – 12,
P - 12**

SQL Introduction – Create Database – Use Database - Create Table – Primary Key and Not Null– Insert Values into Table –Retrieve Values from Table: where, and, or, not order by, between – Delete Record – Drop Table – Alter Table Records – Auto Increment Field.

PHP 7 Introduction –Syntax – Data Types - Variables – Echo/Print – Operators – Conditional Statements – Looping Statements – Functions – Arrays – Sorting Arrays – Date and Time – File Handling – Cookies – Sessions – PHP Database Connectivity.

Unit V – IoT Based Web Server **L -14, P - 14**

Node.js Introduction –Display “Hello World” – Modules – Http Module – File System – URL Module – NPM – Events – Upload Files – Email – Node.js Database SQL Connectivity.

MongoDB Introduction –Create Database – Create Collection – Insert – Find – Retrieve Query – Sort – Delete – Drop Collection – Update.

Raspberry PI Introduction – Set Up Raspberry PI – Set Up Network on the Raspberry PI - Enable SSH, Change Host Name and Password - Install Node.js on Raspberry PI – GIGO Introduction.

I. Learning Resources:

i. Text Books:

2. Deitel&Deitel, Goldberg, “Internet and world wide web – How to Program”, Pearson Education Asia, 2011.
3. SamuliNatri, “Django - The Easy Way”, Independently Published, 2018

4. Mark Edward Scoper, "Expanding Your Raspberry Pi", APress Publication, ISBN: 9781484229217, 1484229215.

ii. References:

5. PHP: The Complete Reference , Stephen Holzner
6. PHP and MYSQL Web development All-in-One Desk Reference for Dummies, John Wiley & Sons
7. Chris Bates, Web Programming – Building Intranet Applications, 3 rd. Edition, Wiley Publications, 2009.
8. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", Pearson Education, 2011.
9. UttamK. Roy, "Web Technologies", Oxford University Press, 2011.

iii. Online Resources:

5. {HYPERLINK "http://W3resource.com/"}
6. {HYPERLINK "https://www.coursera.org/learn/web-applications-php"}
7. {HYPERLINK "https://www.udemy.com/learn-advanced-php-programming/"}
8. {HYPERLINK "http://www.ptutorial.com/"}

INSTITUTE ELECTIVE

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS101	COMPUTER NETWORKS	3	0	0	3

Course Category: Institute Elective

A. Preamble:

This course is to provide students with an overview of the concepts and fundamentals of computer networks. Topics to be covered include: data communication concepts and techniques in a layered network architecture, communications switching and routing, types of communication, network congestion, network topologies, network configuration and management, network model components, layered network models (OSI reference model, TCP/IP networking architecture) and their protocols, various types of networks (LAN, MAN, WAN and Wireless networks) and their protocols.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Students undergoing this course are expected to

- Gain knowledge in data communication and its standards
 - Learn the concepts of various topologies, network components and categories of networks
 - Grasp the functions of different layers and its protocols.
2. Analyze the different types of errors detection and error correction techniques.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Illustrate the various concepts of network topologies, network components, categories of networks and OSI model with its functions	K2

CO2	Classify the various techniques for both analog and digital data communication and its standards.	K2
CO3	Express their knowledge in various error detection and flow control techniques.	K3
CO4	Identify the various network layer protocols.	K2
CO5	Compare various transport layer and application layer protocols	K2

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M	L	M		L				L						
CO2	M	M	M		L										
CO3	M	M	H		L								L	M	L
CO4	M	M	M	L	L	L						L	L	L	L
CO5	M	M	H	L	L	L			L		L	L		L	L

H- High; M-Medium; L-Low

G.Course Content:

UNIT I Introduction

9

Data Communication: Data Communication system components - Network Models - OSI Model - TCP/IP Protocol Suite -Addressing - Data and Signals - Analog and Digital - Transmission Impairment - Data rate and Channel capacity – Performance.

UNIT II Physical Layer

9

Digital Transmission - Digital-To-Digital Conversion - Analog Transmission -
Digital-To-Analog Conversion - Transmission Media - Guided Media - Unguided
Media: Wireless - Wired LANs: Ethernet - Token ring - Connecting Devices – Switching
techniques.

UNIT III Data Link Layer

9

Link Layer: Types of errors -Error detection- VRC, LRC, CRC techniques - Data Forward and backward error correction - Hamming code. Flow control: stop and wait-sliding window protocol, Error control: Stop and wait ARQ- Go-Back-N ARQ- Selective Repeat ARQ Protocols- Asynchronous and Synchronous Protocol - HDLC frames.

UNIT IV Network layer

9

Logical Addressing - IPv4 Addresses - IPv6 Addresses - Address Mapping – ARP – RARP, BOOTP, and DHCP – ICMP – Unicast Routing Protocols - Intra- and Interdomain Routing - Distance Vector Routing - Link State Routing.

UNIT V Transport Layer and Application Layer 9

Process-to-Process Delivery: UDP – TCP - Congestion Control - Quality of Service - Techniques to Improve QoS – Application layer protocols: REMOTE LOGGING - TELNET -ELECTRONIC MAIL – DNS – SMTP – FTP - HTTP.

Total: 45

G. Learning Resources

i.Text Books:

1. Behrouz Forouzan, "Introduction to Data Communications and Networking", Tata McGraw Hill, 5th Edition, 2015.
2. Stallings, "Data and Computer Communications", PHI, 10th Edition, 2015.

ii.Reference:

1. WilliamSchweder, "Data Communication", McGraw Hill, 1987.
2. Tanenbaum, "Computer Networks", PHI, 5rd Edition, 2011

iii. Online Resources

1. {HYPERLINK "<http://www.cse.iitk.ac.in/users/dheeraj/cs425/>"}
2. {HYPERLINK "http://www.tcpipguide.com/free/t_OSIReferenceModelLayers.htm"}

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS102	JAVA PROGRAMMING FOR ENGINEERS	3	0	0	3

Course Category: Institute Elective

A. Preamble:

Most of the software need to develop runs in cross platform. Java is the one of the pioneer software development tools developed used for cross platform development software. From the system towards the handheld devices all place Java become one of the most dominant software. This course provides a basic concept about Object Oriented Programming, Database connectivity, Networking and finally provides programming skills in java. After successful completion of this course learners can able to develop software modules for real world problem.

B. Pre-requisites:

Sl No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl No	Course Code	Course Name
		NIL

D. Course Educational Objectives:

Students undergoing this course are expected to:

- Understand basic in Java Programming.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc.
- Familiarize in important topics and principles of software development.
- Have the ability to write a computer program to solve specified problems.
- Use the Java SDK environment to create, debug and run simple Java programs.

E. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Design and implement basic data types and control flow constructs using J2SE or other Integrated Development Environments.	K3
CO2	Implement Java programs using object-oriented class structures with parameters, constructors, and utility and calculations methods, including inheritance, test classes and exception handling.	K3
CO3	Demonstrate multitasking using Threads.	K2
CO4	Build simple applications using GUIs and event driven programming	K3
CO5	Develop applets for inclusion in web pages; applets to access enterprise data bases in robust, enterprise applications	K3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	M				L									L	
CO2	M		M	M	L									M	
CO3	M		M	L	L										L
CO4	M	L	M	L	L			L	L		L	L	L	H	L
CO5	M	M	M	M	L	L		L	L		L	L		H	L

H- High; M-Medium; L-Low

G. Course content:

UNIT I INTRODUCTION TO JAVA

9

Basic concepts of object-oriented programming and Benefits of OOP – Instruction about Simple java program- fundamentals- Class fundamentals - constructors - this keyword - garbage Collection and finalize () - Arrays & Strings - Functions – Command line Arguments.

UNIT II INHERITANCE AND PACKAGE

9

Basic concept of Inheritance: Polymorphism - Making methods and classes final - Abstract classes and methods – Interfaces. Package: Introduction about package-package creation and package access.

UNIT III THE EXCEPTION AND THREADS 9

Exception:Exception Types - Uncaught Exceptions - Using Try Catch - Multiple Catch - Nested try and throw – Throws – finally - Built in Exceptions - Using Exceptions. Multithreaded Programming: Thread model –Creating a thread - Creating multiple thread –Thread Priority – Thread Scheduling – Thread Synchronization.

UNIT IV APPLET AND AWT COMPONENTS 9

Applet: Introduction of Applet – Life cycle of Applet – Passing parameters to applet
AWT:

AWT classes – Event Model – Swing classes

UNIT V DATABASE CONNECTIVITY AND NETWORK BASICS 9

Introduction of JDBC: JDBC Drivers – Database connection – Getting Data from a table
Java and Net: InetAddress – URL Connection - TCP/IP Client socket –TCP/IP Server socket – Datagrams.

i.TEXT BOOK

1. PatricNaughton , Herbert Schildt, *The Complete Reference "Java 2"*, Third edition Tata Mc Graw Hills ,1999.

ii.REFERENCE BOOKS

1. H.M. Deitel and P.J.Deitel – “**Java How to Program**” Pearson Prentice Hall Sixth Edition, 2009.
2. E. Balaguruswamy,*Programming in java* , Second Edition,TMH,1999.
3. Graham Hamilton, Rick Cattell, Maydene Fisher ,”*JDBC Database access with java*”- 1997
4. Bruce Eckel – “**Thinking in Java**” Pearson Prentice Hall Third Edition-2006

WEB REFERENCES

1. docs.oracle.com/javase/6/tutorial/doc/girgm.html
2. www.webreference.com/programming/java.html
3. {HYPERLINK "<http://www.apl.jhu.edu/~hall/java/Documentation.html>"}

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS103	C++ Programming	3	0	0	3

Course Category: Institute Elective

A. Preamble:

To master all techniques of software development in the C++ Programming Language and demonstrate these techniques by the solution of a variety of problems spanning the breadth of the language including C++

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		Nil

D. Course Educational Objectives:

Learners are exposed to

- Understand of the utility of object-oriented programming over procedure-oriented programming.
- Know the concept of code reusability to use third party code in the form of predefined classes to write their programs.
- Use the programs written by others and write the programs that can be used by others without exposing the source code, using package and interface concepts.
- Understand exception handling mechanism for handling exceptional situation that occur during run time.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Design the solution to a problem using object-oriented programming concepts.	K3
CO2	Apply the concepts of constructors and function overloading for developing the code.	K3

CO3	Implement exceptions and file handling for providing solutions to problems										K3		
CO4	Illustrate the purpose of virtual functions that is used to implement polymorphism and inheritance.										K2		
CO5	Demonstrate the features of C++ including templates.										K3		

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	M	M		L							L		M	
CO2	M	H	M	M	L				L					M	
CO3	M	H	M	M	L				L		L			M	L
CO4	M	M	M	M	L			M						H	
CO5	M	M	M	M	L			M						H	M

H- High; M-Medium; L-Low

G. Course Content:

UNIT I

9

Object oriented programming concepts – objects – classes – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism. Introduction to C++ – classes – access specifiers – function and data members – default arguments – function overloading – friend functions – const and volatile functions - static members – Objects – pointers and objects – constant objects – nested classes – local classes

UNIT II

9

Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor – destructors – operator overloading – overloading through friend functions – overloading the assignment operator – type conversion – explicit constructors

UNIT III

9

Function and class templates - Exception handling – try-catch-throw paradigm – exception specification – terminate and unexpected functions – Uncaught exception.

UNIT IV

8

Inheritance – public, private, and protected derivations – multiple inheritance - virtual base class – abstract class – composite objects Runtime polymorphism – virtual functions – pure virtual functions

UNIT V

10

RTTI – typeid – dynamic casting – RTTI and templates – cross casting – down casting.
Streams and formatted I/O – I/O manipulators - file handling – random access – object serialization – namespaces - std namespace – ANSI String Objects – standard template library

.

H. Learning Resources

i. Text Book

1. B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

Ii. Reference Books

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Second Edition Reprint 2004.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Fourth Edition, Pearson Education, 2005.

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS104	ANDROID MOBILE APPLICATION DEVELOPMENT	3	0	0	3

Course Category: Institute Elective

A. Preamble:

In this modern era almost, every hand has a handheld device. Each handheld device has the computing capability to meet the half the needs of user such as banking, browsing, education and emergency etc. It is good for an engineer to have some basic knowledge about the handheld devices platform and its supporting software development. This course will give adequate knowledge in developing a mobile application for android platform.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
		NIL

C. Related Courses:

Sl. No	Course Code	Course Name
		NIL

D. Course Educational Objectives:

Learners are exposed to

- Basics about mobile platform
- Techniques in implementation, software design, and user-interaction design for mobile application.
- Packaging and distributing the apps.

Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Understand mobile platform and mobile app development	K2
CO2	Develop simple android application	K3
CO3	Familiarize in Graphics and Sensors used for Android application development	K2

CO4	Apply the testing strategies for developed application										K3		
CO5	Build the App and publish it in the market										K3		

E. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M	L			M	L								L	
CO2	M		L		H	M								H	L
CO3	M		M		H	M	L						L	H	L
CO4	M	L			H	L		M						M	L
CO5	L				H	M			L		L	L			H

H- High; M-Medium; L-Low

F. Course Content:

UNIT I GETTING STARTED WITH MOBILITY 9
 Mobility landscape- Mobile platform- Mobile apps development, Overview of Android platform-setting up the mobile app development environment along with an emulator- case study on Mobile app development.

UNIT II BUILDING BLOCKS OF MOBILE APPS 9
 App user interface designing – mobile UI resources (Layout, UI elements, Drawable, Menu), Activity- states and life cycle, interaction amongst activities-App functionality beyond user interface - Threads, Async task, Services – states and lifecycle, Notifications, Broadcast receivers, Telephony and SMS.

UNIT III SPRUCING UP MOBILE APPS 9
 Graphics and animation – custom views, canvas, animation APIs, multimedia – audio/video playback and record location awareness- native hardware access (sensors such as accelerometer and gyroscope)

UNIT IV TESTING MOBILE APPS 9
 Debugging mobile apps- White box testing-Black box testing- test automation of mobile apps- JUnit for Android- Robotium- MonkeyTalk

UNIT V TAKING APPS TO MARKET 9
 Versioning, signing and packaging mobile apps, distributing apps on mobile market place

Total: 45

G. Learning Resources

i. Text Books

1. "Anubhav Pradhan, Anil V Deshpande" Composing Mobile Apps Learn | Explore | Apply using Andriod, Wiley Publications 1st Edition 2014.
2. Jeff McWherter and Scott Gowell "ProfessionalMoblile Application Development" John Wiley & Sons Ltd.
3. Mark Gargenta, "Learning ANDROID", Oreilly Publication, First Edition, March 2011.

ii. Reference Books

1. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012

iii. Online Resources

1. {HYPERLINK "<http://developer.android.com/develop/index.html>"}
2. {HYPERLINK "<https://www.tutorialspoint.com/android/>"}
3. {HYPERLINK "<https://www.javatpoint.com/android-tutorial>"}

iv. Android Application Resources

1. <https://play.google.com/store/apps/details?id=arjuntoshniwal.androidtutorials.advanced&hl=en>

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS105	SOFTWARE ENGINEERING	3	0	0	3

Course Category: Institute Elective

A. Preamble :

Software engineers are those who contribute by direct participation or by teaching, to the analysis, specification, design, development, certification, maintenance, and testing of software systems

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS201	Problem solving using C

C. Related Courses:

Sl No	Course Code	Course Name
NIL		

D. Course Educational Objectives :

Students undergoing this course are expected to

- Understand conventional software management, software economics evolution
- Get the knowledge about life cycle phases, iterative process planning, organization and responsibilities and process automation can be understood
- Learn modern project profiles, next generation of software economics and modern project transition can be understood

E. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Identify an appropriate process model to develop a software	K3
CO2	Summarize the principles involved in gathering and validating software requirements	K2
CO3	Illustrate the knowledge on testing methods and comparison of various testing techniques.	K2
CO4	Infer the quality assurance procedures during software development.	K2
CO5	Summarize the current technologies, by managing resources economically and keeping ethical values in software engineering and maintenance Explain software project management and software maintenance practices	K2

F. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	M							L						
CO2	L	L	H												L
CO3	L			H	L			L							L
CO4	L			M											
CO5	L	L		M								M			

H- High; M-Medium; L-Low

Course Content:

UNIT I INTRODUCTION

9

Introduction to Software Engineering, Software Process, Perspective and Specialized Process Models – Unified Process-Personal and Team Process Model- Agile development-Agile Process- Extreme Programming-Other Agile Process Models- A Tool set for the agile process.

UNIT II REQUIREMENTS ANALYSIS AND DESIGN

9

Software Requirements Document- Understanding Requirements- Design process – Design Concepts-Design Model– Design Heuristic – Architectural Design –

Architectural styles, Architectural Mapping using Data Flow- User Interface Design: Interface analysis, Interface Design –Component level Design-Pattern Based Design

UNIT III TESTING AND IMPLEMENTATION

9

Software testing fundamentals-Internal and external views of Testing-white box testing-basis path testing-control structure testing-black box testing- Regression Testing – Unit Testing – Integration Testing – Validation Testing – System Testing and Debugging – Software Implementation Techniques: Coding practices-Refactoring-Testing Tools

UNIT IV QUALITY MANAGEMENT

9

Quality Concepts- Review Techniques- Software Quality Assurance- Software Configuration management- Product and Project Metrics- Software Estimation- Project Scheduling Risk management

UNIT V MAINTENANCE AND REENGINEERING

9

Software Maintenance and reengineering-Software Process Improvement- Emerging Trends in Software Engineering

Total: 45 Hour

G. Learning Resources

i. Text Books :

1. Roger. S. Pressman and Bruce R. Maxim, "Software Engineering – A Practitioner's Approach", eighth Edition, McGraw Hill ,International Edition, Singapore, 2015.
2. Ian Sommerville, "Software Engineering", sixth Edition, Pearson Education, New Delhi, 2001.
3. Microsoft Project 2007 for Dummies.

ii. Reference:

1. Ali Behforooz, Frederick J Hudson, "Software Engineering Fundamentals", second edition, Oxford University Press, Noida, 2003.

2. Fairley R, "Software Engineering Concepts", second edition, Tata McGraw Hill, New Delhi, 2003.
3. Jalote P, "An Integrated Approach to Software Engineering", third edition, Narosa Publishers, New Delhi, 2005.

iii. Online resources

1. <http://www.slideshare.net/rhspcte/software-engineering-ebook-roger-s-pressman>
2. <https://docs.google.com/folderview?id=0B2Q8Nd2L-6PjZDVmZjg3ZDUtN TYwMy00ODBILTk4NzQtYWMzM2I3OWI0MDg4&tid=0B2Q8Nd2L-6PjMmNIYzk3YmMtZWQxZC00ODdmLWE5N2MtZmFmNjY5ZjY0NGj>
3. {HYPERLINK "http://www.londoninternational.ac.uk/sites/default/files/.../co3353_ch1-3.pdf"}
4. users.encs.concordia.ca/~grogono/CourseNotes/COMP-354-Notes.pdf
5. ufesmestradoanabringuente.googlecode.com/.../Thayer-SE-Proj-Mgt.pdf
6. devedzic.fon.rs/publications/SEKE-Handbook-2.pdf

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS106	DATA STRUCTURES	3	0	0	3

Course Category: Institute Elective

A. Preamble:

This course provides an introduction to the basic concepts and techniques of Linear and nonlinear data Structures and Analyze the various algorithm.

B. Prerequisite Courses:

S1 No	Course Code	Course Name
1	1150CS201	Problem solving using C

C. Related Courses:

S1 No	Course Code	Course Name
1	1156CS701	Project

D. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Develop Abstract Data Types (ADT) for linear data structures and implement the same.	K3
CO2	Implement non-linear data structures such as trees	K3
CO3	Illustrate some of the special trees and Hashing Techniques.	K2
CO4	Construct solutions for various real life applications using graphs and apply BFS and DFS to traverse a graph	K3
CO5	Demonstrate knowledge of sorting algorithms and their run-time complexity.	K3

E. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3
CO1	H	M		M	L								M	M	
CO2	H	M	L	M	L								M	M	M
CO3	M	M		M	L								M		

CO4	H	H	H	M	L	L		L	L		L	L	M	M	M
CO5	H	H	L	M	L				L				M	M	L

H- High; M-Medium; L-Low

F. Course Content:

UNIT I LINEAR DATA STRUCTURE 9
 Introduction - Time and space complexity analysis - Abstract Data Type (ADT) – The List ADT – Array Implementation – Linked List Implementation– the Stack ADT – The Queue ADT – Applications of Stack, Queue and List.

UNIT II TREES 9
 Introduction to trees - Tree Traversal - Binary Trees - Definitions – Expression Tree – Binary Tree Traversals - The Search Tree ADT – Binary Search Trees - AVL Tree.

UNIT III SPECIAL TREES & HASHING 9
 Splay Tree – B-Tree - Priority Queue - Binary Heap -. Hashing - Separate Chaining – Open Addressing – Linear Probing – Quadratic Probing – Double Hashing –Rehashing

UNIT IV GRAPH 9
 Introduction to Graphs - Topological Sort – Shortest-Path Algorithms – Unweighted Shortest Paths –Dijkstra's Algorithm – Minimum Spanning Tree – Prim's Algorithm- Kruskal's Algorithm – Breadth first search – Depth-First Search – Undirected Graphs – Biconnectivity.

UNIT V SORTING & SEARCHING 9
 Sorting algorithm- Insertion sort- Selection sort- Shell sort-Bubble sort- Quick sort- Heap sort-Merge sort- Radix sort - Searching – Linear search - Binary search.

Total: 45 Periods

G. Learning Resources

i. Text Books:

1. M. A. Weiss, "Data Structures and Algorithm Analysis in C", Second Edition , Pearson Education, 2007.

ii. Reference:

1. A. V. Aho, J. E. Hopcroft, and J. D. Ullman, "Data Structures and Algorithms", Pearson Education, First Edition Reprint 2003.
2. R. F. Gilberg, B. A. Forouzan, "Data Structures", Second Edition, Thomson India Edition, 2005.
3. Ellis Horowitz, Sartaj Sahni, Dinesh Mehta, "Fundamentals of Data Structure",

Computer Science Press, 1995.

iii. Online resources

1. <http://simplenotions.wordpress.com/2009/05/13/java-standard-data-structures-big-o-notation/>
2. <http://mathworld.wolfram.com/DataStructure.html/.>

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS201	PROBLEM SOLVING USING C++	2	0	4	4

A. Preamble:

To master all techniques of software development in the C++ Programming Language and demonstrate these techniques by the solution of a variety of problems spanning the breadth of the language including C++

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses: NIL

D. Course Educational Objectives:

Learners are exposed to

- Understand of the utility of object-oriented programming over procedure-oriented programming.
- Know the concept of code reusability to use third party code in the form of predefined classes to write their programs.
- Use the programs written by others and write the programs that can be used by others without exposing the source code, using package and interface concepts.
- Understand exception handling mechanism for handling exceptional situation that occur during run time.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Develop the programs in C++ using object-oriented concepts.	K3
CO2	Implement programs that relate to procedures and functions	K3
CO3	Illustrate the concept of streams for real world applications.	K3
CO4	Implementing Flow control in C++ program in an efficient manner.	K3
CO5	Demonstrate the concept of Arrays, Pointers and inheritance.	K3

F. Correlation of COs with POs:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	L	L	L		L										M
CO2	L	L	L	L	L			L							M
CO3	L	L	L	L	L	L						L			
CO4	L	M	M	M	L			L							M
CO5	L	M	M	M	L	L			L		L				M

G. Course Content:

Unit I Introduction to Computers and C++ Programming

L-6, P-12

Introduction to C++: A Sample C++ Program, Programming Tip: Input and Output Syntax. Layout of a Simple C++ Program, Compiling and Running a C++ Program, Testing and Debugging, Kinds of Program Errors, Variables, Identifiers, Variable Declarations, Assignment Statements, Input and Output, Data Types, Operators and Expressions, More Assignment Statements, Branching and Loop Mechanisms.

Unit II Procedural Abstraction and Functions.

L-6, P-12

Top-Down Design, Predefined Functions, Using Predefined Functions, Type Changing Functions, Defined Functions, Function Definitions, Global Constants and Global Variables, Call-by-Value Formal Parameters Are Local Variables, Introduction to Overloading.

Unit III Functions and I/O Streams

L-6, P-12

Void-Functions, Definitions of void-Functions, Return-Statements in void-Functions, Call-by-Reference Parameters, Call-by-Reference, Using Procedural Abstraction, Functions Calling Functions, Preconditions and Post conditions. Streams and Basic File I/O, Streams and Basic File I/O, File I/O. Classes and Objects: Techniques for File I/O, Tools for Stream I/O, Formatting Output with Stream Functions, Streams as Arguments to Functions, Character I/O, Predefined Character Functions

Unit IV Classes, Abstract Data Types, Flow of Control

L-6, P-12

Structures, Structures as Function Arguments, Classes, Defining Classes and Member Functions.

Public and Private Members, Abstract Data Types, Classes to Produce ADTs, Using

Logical Expressions, Logical Expressions, Multiway Branches, Nested Statements, Multiway if-else-Statements, theswitch-Statement, thefor-Statement, thebreak-Statement, Defining ADT Operations, Friend Functions, Overloading Operators, Overloading Unary Operators, Overloading >> and <<.

Unit V Arrays, Strings, Pointers, Inheritance

L-6, P- 12

Introduction to Arrays - types of array, Declaring and Referencing Arrays, Arrays in Functions, Arrays and Classes, Arrays of Classes, String-String Input and Output, Recursion, Pointers-Pointer Variables, Pointers and Linked Lists. Inheritance-Programming with Inheritance, Virtual Functions

Total: 90

Text Book

1. B. Trivedi, "Programming with ANSI C++", Oxford University Press, 2007.

Reference Books

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Second Edition Reprint 2004.
 2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Fourth Edition, Pearson Education, 2005.
- B. Stroustrup, "The C++ Programming language", Third edition, Pearson Education, 2004

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS301	MOBILE APP DEVELOPMENT USING ANDROID STUDIO	0	0	2	1

Course Category: Institute Elective

A. Preamble:

In this modern era almost, every hand has a handheld device. Each handheld device has the computing capability to meet the half the needs of user such as banking, browsing, education and emergency etc. It is good for an engineer to have some basic knowledge about the handheld devices platform and its supporting software development. This course will give adequate knowledge in developing a mobile application for android platform.

B. Prerequisites:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		NIL

D. Course Educational Objectives:

Learners are exposed to

- Basics about mobile platform
- Techniques in implementation, software design, and user-interaction design for mobile application.
- Database connectivity with apps.

E. Course Outcomes

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Apply the basics of android and UI Element	S3
CO2	Demonstrate Threading and Services	S2

CO3	Demonstrate Animation and Sensors												S2
CO4	Demonstrate App With Database												S2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M		M		H	L								H	
CO2	M		M		H	L								H	
CO3	M	L	H		H	M			L		L			H	
CO4	M	L	H		H	M		L	L		L	L	M	H	L

G. Lab Experiment:

P-30

1. Setting up android and android emulator
2. Creating UI element – Layout
3. Creating UI element – Button
4. Creating UI element - Menu
5. Demonstrating Thread
6. Demonstrating Services
7. Creating Animation view and canvas
8. Listing the sensors used in mobile phone
9. Creating data base using SQLite
10. Interaction with Data Base

H. Learning Resources

i. Text Books

1. "Anubhav Pradhan, Anil V Deshpande" Composing Mobile Apps Learn|Explore|Apply using Andriod, Wiley Publications 1st Edition 2014.

ii. Reference Books

1. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012

iii. Online Resources

1. {HYPERLINK "http://developer.android.com/develop/index.html"}
2. {HYPERLINK "https://www.tutorialspoint.com/android/"}
3. {HYPERLINK "https://www.javatpoint.com/android-tutorial"}

iv. Android Application Resources

1. {HYPERLINK "https://play.google.com/store/apps/details?id=arjuntoshniwal.androidtutorials.advanced&hl=en"}

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COURSE CODE	COURSE TITLE	L	T	P	C
1154CS203	ANDROID PROGRAMMING	2	0	4	4

Course Category: Institute Elective

A. Preamble :

In this modern era almost, every hand has a handheld device. Each handheld device has the computing capability to meet the half the needs of user such as banking, browsing, education and emergency etc. It is good for an engineer to have some basic knowledge about the handheld devices platform and its supporting software development. This course will give adequate knowledge in developing a mobile application for android platform.

B. Prerequisite Courses:

Sl. No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl. No	Course Code	Course Name
		NIL

D. Course Educational Objectives:

- Learners are exposed to
- Basics about mobile platform
 - Techniques in implementation, software design, and user-interaction design for mobile application.
 - Database connectivity with apps.

E. Course Outcomes:

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Level of learning domain (Based on revised Bloom's taxonomy)
CO1	Illustrate the basics of Java programming	K2, S2
CO2	Apply the basics of android and UI Element	K3, S3
CO3	Demonstrate Threading and Services	K2, S2
CO4	Demonstrate Animation and Sensors	K2, S2
CO5	Demonstrate App With Database	K2, S2

F. Correlation of COs with POs:

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	M				M						L			M	
CO2	M		M		H									H	
CO3	M	L	M		H	L								H	
CO4	M	L	H		H	L								H	
CO5	M	L	H		H	L	L	L	M		M		M	H	H

H- High; M-Medium; L-Low

G. Course Content:

UNIT I Basics of JAVA 6

Basic concepts of object-oriented programming, Tokens, Keywords, Identifiers, Data type, Arrays and Operators, Class fundamentals, constructors, this keyword, overloading methods

UNIT II Introduction to Android Development Environment 6

Mobility landscape- Mobile platform- Mobile apps development, Overview of Android platform-setting up the mobile app development environment along with an emulator

UNIT III Building Blocks of App Development 6

App user interface designing – mobile UI resources (Layout, UI elements, Drawable, Menu)

UNIT IV Activity 6

Activity- states and life cycle, interaction amongst activities-Services-Notifications – Icon –Toast Messages

UNIT V Data Base in App 6

Introduction to SQLite-App, Versioning, signing and packaging mobile apps, distributing apps on mobile market place

Lab Experiment: P-60

1. Java Program – Creating class
2. Java Program – Implementing Inheritance
3. Java Program – Implementing Over riding

4. Java Program – Implementing this key word
5. Setting up android and android emulator
6. Creating UI element – Layout
7. Creating UI element – Button
8. Creating UI element - Menu
9. Demonstrating Thread
10. Demonstrating Services
11. Creating Animation view and canvas
12. Listing the sensors used in mobile phone
13. Creating data base using SQLite
14. Interaction with Data Base

Total: 90

H. Learning Resources

i.Text Books

1. E. Balaguruswamy, Programming in java, Fourth Edition, TMH, 2010.
2. "Anubhav Pradhan, Anil V Deshpande" Composing Mobile Apps Learn | Explore | Apply using Andriod, Wiley Publications 1st Edition 2014.

ii.Reference Books

2. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 2012

iii.Online Resources

1. {HYPERLINK "http://developer.android.com/develop/index.html"}
2. {HYPERLINK "https://www.tutorialspoint.com/android/"}
3. {HYPERLINK "https://www.javatpoint.com/android-tutorial"}

iv.Android Application Resources

1. {HYPERLINK "https://play.google.com/store/apps/details?id=arjuntoshniwal.androidtutorials.advanced&hl=en"}

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS204	CODING TECHNIQUES – I	2	0	2	3

Course Category: Institute Elective (All branches except CSE and IT)

A.Course Content:

UNIT I FUNDAMENTALS OF PROGRAMMING L-6, P-6

Fundamentals of programming through C – structure of a C program – compilation and linking processes – Constants, Variables – Tokens– Data Types – Format Specifiers, Input and Output statements –operators - Expression evaluation in C – Type qualifiers – Type Modifiers – Type def

Branching – if, if-else, else-if ladder, nested if, switch and goto statements - Loops – while, do-while, for statements.

Practice: problems on data formats, operator's precedence and associativity, basic Conditional programs and Pattern display programs.

UNIT II ARRAYS, STRINGS, POINTERS L-6, P-6

Arrays – Initialization – Declaration – One dimensional, Two dimensional and Multi-dimensional arrays. Strings –Operations on strings, string functions

Pointers – Introduction to Program Memory, storage of data, Runtime memory allocation – Pointer Arithmetic - Pointer to an Array – pointer to linear data, runtime array,pointer to 2D-array.

Practice: problems on RMO and CMO representations of an array, spiral display of a 2D array and matrix operations

UNIT III FUNCTIONS, RECURSIONS AND STORAGE CLASSES L-6, P-6

Functions – Introduction to modular programming – Function Communication - Pass by value, Pass by reference – Function pointers – Recursions – Type casting – Storage classes

Practice: programs on passing an array and catching by a pointer, function returning data, comparison between recursive and Iterative solutions

UNIT VI STRUCTURES, UNIONS, ENUMERATIONS PRE-PROCESSOR DIRECTIVES L-6, P-6

Need for user-defined data type – structure definition – Structure declaration – Array within a Structure – Array of Structures – Nested Structures - Unions–Declaration of Union data type, Struct Vs Union - Enum– Pre-processor directives

Practice: Structure padding, user-defined data storage and retrieval programs

UNIT V FILE STORAGE AND OOP**L-6, P-6**

Pre-Processor Directives, Introduction to Standard Storage, Types of Files, opening and closing a file, I/O operations on a File, File handling functions.

Procedure vs. object-oriented programming – Data types – control structures – Operator Overloading – Inheritance – Polymorphism and Virtual Functions, Function templates and class templates – Name spaces – Casting – Exception Handling, Stream classes – Formatted IO – File classes and File operations – Dynamic memory allocation – Standard Template Library

Practice: I/O through files, class and object, Implementation of OOP concepts.

TOTAL:30+30=60 PERIODS

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS205	CODING TECHNIQUES – II	2	0	2	3

Course Category: Institute Elective (All branches except CSE and IT)

Course Content:

UNIT I REVIEW OF PROGRAMMING **L-6,**

P-6

Arrays – 1D, 2D and Multi-Dimensional Arrays. Matrix Operations. Pointers – Pointer arithmetic, array pointers and function pointers. Functions – function communication and function recursions

UNIT II LINKED LISTS **L-6, P-6**

Introduction to Linked Lists, Operations on a Linked List, Traversals - Doubly Linked List – Circular Linked List

UNIT III STACKS AND QUEUES **L-6, P-6**

Stack – Introduction to stack data structure, Stack operations, Infix, Prefix and Postfix evaluations, Stack using Array and Linked list.

Queue – Introduction to Queue, Queue operations, Queue using an Array and Linked list

UNIT IV TIME COMPLEXITY, SORTING AND SEARCHING **L-6, P-6**

Introduction to time complexity - Searching – Linear search, Binary search techniques – Sorting Methods – Bubble sort, Selection sort, Insertion sort, Quick sort, Merge sort.

UNIT V DATABASE MANAGEMENT SYSTEM **L-6, P-6**

DBMS –ER And Relational Models, Data Definition and Querying, Transactions and Concurrency, Advanced Topics in Databases.

TOTAL:30+30=60PERIODS

COURSE CODE	COURSE TITLE	L	T	P	C
1154CS107	FUNDAMENTALS OF IOT	3	0	0	3

Course Category: Institute Elective

A. Preamble :

The core modules of this elective course include introduction to IoT, Elements of IoT, Data Analytics and IoT Platform. This course aims to teach the student to understand the concepts of Internet of Things(IoT) and its applications.

B. Prerequisite Courses:

Sl No	Course Code	Course Name
1	1150CS201	Problem Solving using C

C. Related Courses:

Sl No	Course Code	Course Name
1	1156CS601	Minor Project
2	1156CS701	Major Project

D. Course Outcomes :

Upon the successful completion of the course, students will be able to:

CO Nos.	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Understand the concepts of Internet of Things.	K2
CO2	Explain the fundamentals and protocols in IoT	K2
CO3	Understand the basics of industrial IoT and clustering	K2
CO4	Explain the IoT concepts of Big data and cloud computing.	K2
CO5	Express the knowledge about Arduino and Raspberry Pi.	K2

E. Correlation of COs with POs :

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO1	M															
CO2	M	L													L	
CO3	M	L			L										L	
CO4	M				L										L	
CO5	M	L		M	L				M	L	L	L			L	

H-High M-Medium L-Low

F. Course Content :

Unit I Introduction 9

Introduction – Definition and characteristics of IoT – Physical and Logical Design of IoT - Communication models and APIs – Challenges in IoT - Evolution of IoT – IoT Architecture - and Core IoT Functional Stack.

Unit II Fundamentals and Protocols: 9

Components in internet of things: Control Units – Sensors – Communication modules – Power Sources – Communication. Basic of Networking – Communication protocols – M2M and WSN Protocols- Supervisory Control and Data Acquisition and RFID Protocols, CoAP and MQTT.

Unit III Industrial IoT and Clustering 9

Cybersecurity in Industry 4.0 - Industrial IoT- Layers – Network Layers, IEEE 802.15.4, ZigBee Architecture. Clustering – Role of Machine language - Software Agents - Software Agents for Object

Unit IV Big Data and Cloud Computing concepts in IoT 9

Big Data Analytics and Software Defined Networks- No SQL Databases - Data Management with Hadoop - Security and Fog Computing - Cloud Computing - Cloud Standards -Cloud of Things Architecture - Open Source e-Health sensor platform.

Unit V Implementation and its Applications 9

Introduction to Arduino Programming – Installation of Arduino (IDE) – Getting started with Circuits – Components used in circuits – Fritzing for circuit design - IDE programming – Raspberry Pi – Interfaces and Raspberry Pi with Python Programming - Integration of Sensors and Actuators with Arduino.

G. Learning Resources

i. Text Books

1. David Hanes, Gonzalo Salgueiro, Patrick Grossete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", Cisco Press, 2017.
2. Michael Margolis, "Arduino Cookbook" O'Reilly, Second Edition, 2011.

ii. References

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", VPT, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2012.

iii. Online Resources

1. <https://www.arduino.cc>
2. <http://www.theinternetofthings.eu/what-is-the-internet-of-things>

Value Education Elective

COURSE CODE	COURSE TITLE				L	T	P	C
1155CS101	Ethics in Engineering				1	0	0	1

Course Category: Value Education Elective

A. Preamble:

To provide guiding principles and tools for the development of the whole person recognizing that the individual is comprised of Physical, Intellectual, Emotional and Spiritual dimensions and to create an awareness on Engineering Ethics and Human Values,
to inculcate Moral and Social Values.

B. Pre-requisites: Nil

C. Related Courses: Nil

D. Course Outcomes:

Students undergoing this course are able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO 1	To promote the importance in value education in society, deepen understanding, motivation and responsibility with regard to making value education.	K2
CO 2	To inspire individuals to choose their own personal, social, moral and spiritual.	K2
CO 3	To understand the engineering ethics and moral dilemmas	K2
CO 4	To help individuals think about and reflect on different values and to Know the importance of value education towards national and global development.	K2
CO 5	To Develop professionals in software industry with idealistic, practical and moral values.	K2

E. Correlation of COs with POs:

COs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3

CO1					H	M	H	H						
CO2					L	M	H	H						
CO3					H	L	H	H						
CO4					L	L	H	H						
CO5					M	M	H	H						

H- High; M-Medium; L-Low

F. Course content:

UNIT I: EDUCATION AND VALUES

3

Importance of Value Education -Definition, Concept, Classification, Criteria And Sources Of Values - Aims And Objectives Of Value Education -Role And Need For Value Education In The Contemporary Society -Role Of Education In Transformation Of Values In Society - Role Of Parents, Teachers, Society, Peer Group And Mass Media In Fostering Values -Teaching Approaches And Strategies To Inculcate Values Through Curricular And Co-Curricular Activities-Need Of Yoga And Meditation For Professional Education And Stress Management.

UNIT II: ETHICS, HUMAN VALUES AND PERSONAL DEVELOPMENT

3

Ethics: Morals, Values And Ethics ,Work Ethic, Environmental Ethics, Computer Ethics- Code Of Conduct- **Human Values:** Truthfulness, Constructivity, Sacrifice, Sincerity, Self-Control, Altruism, Scientific Vision, Relevancy Of Human Values To Good Life-**Spirituality-Personal Development :**Character Formation Towards Positive Personality -Modern Challenges Of Adolescent: Emotions And Behavior -Self-Analysis And Introspection: Sensitization Towards Gender Equality, Physically Challenged, Intellectually Challenged, Respect To - Age, Experience, Maturity, Family Members, Neighbors, Co-Workers

UNIT III ENGINEERING ETHICS AND MORAL DILEMMAS

3

Need of Engineering Ethics- The code of ethics for engineers – Societies for engineers- NSPE Code of Ethics- Ethical and Unethical practices -Engineering As An Ethical Profession- Ethical Issues Faced By Engineers- Moral Dilemmas - Procedures For Facing Moral Dilemmas- Moral Dilemma Scenarios- Resolving An Moral Dilemma- Solving

UNIT IV: VALUE EDUCATION TOWARDS NATIONAL AND GLOBAL DEVELOPMENT 3

Personal values: Self-Strengths, Weaknesses -Professional Values: Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith- Constitutional Values: Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity- Social Values: Pity and Probity, Self-Control, Universal Brotherhood-Religious and Moral Values: Tolerance, Wisdom, Character.

UNIT V CODE ETHICS IN SOFTWARE DEVELOPMENT

3

Need A Code Of Ethics For Software Development-Ethics, Values And Practices For Software Professionals-Ethics In Computing, From Academia To Industry-Principles Of Software Ethics-Rewriting The Code For Ethics In Software Development-Ethics Of Security-Privacy Ethics – Ethics In A Psychological Perspective- Ethical Issues In Software Industry-Issues In Professional Ethics In Software Project Management-Ethical Issues In Information Technology.

TOTAL: 15

G. Learning Resources

i. Text Books

1. Mike W. Martin And Roland Schinzingher, "Ethics In Engineering", Tata McGraw Hill, New Delhi, 2003.
2. Sharma, S.P. *Moral and Value Education; Principles and Practices*, Kanishka publishers, 2013.
3. Kiruba Charles & V. Arul Selvi. *Value Education*: Neelkamal Publications, New Delhi, 2012.
4. Passi, B.K. and Singh, P. *Value Education*. National Psychological Corporation, Agra. 2004.

ii. Reference Books

1. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", Prentice Hall Of India, New Delhi, 2004.
2. Monica J. Taylor. *Values in Education and Education in Value*. Routledge. 1996.

iii. Digital Resources

- www.onlineethics.org
- www.nspe.org
- www.globalethics.org
- {HYPERLINK "http://Www.Ethics.Org"}

COURSE CODE	COURSE TITLE	L	T	P	C
1155CS102	COMPUTER ETHICS	1	0	0	1

Course Category: Value Education Elective

Preamble:

This course offers an in-depth examination of the ethical concepts and contexts which are relevant to computer engineering. Drawing from contemporary research in ethical philosophy, and from concrete engineering case studies, the course offers a challenging but accessible guide for practicing computer engineers to get to grips with the ethical dimensions of their work. The course takes as its focus the notion of moral responsibility, and explores the difficulties of assigning and taking moral responsibility when working in computer engineering field. It also examines in detail about various ethically complex contexts, clarifying and exploring the ethical concepts.

Pre-requisites: Nil

Related Courses: Nil

Course Outcomes:

Upon successful completion of this course, students will be able to:

CO Nos	Course Outcomes	Knowledge Level (Based on revised Bloom's Taxonomy)
CO1	Identify the ethical issues surrounding computers, their causes, and moral rules which may have been compromised in a particular context	K2
CO2	Understand the Privacy risk and the laws to protect the privacy	K2
CO3	Understand the philosophical bases of intellectual property and the rationale for the legal protection of intellectual property.	K2
CO4	Identify laws that apply to computer crimes and examine the ethical and legal issues pertaining to the software products	K2
CO5	Understand the social issues related to ethics in Intelligent machines, Health and Government	K2

Correlation of COs with POs:

COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
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CO1					H	M	H	M			M			
CO2					H		H	M	M	M	L			
CO3					H	M	H	M			M			
CO4					H	H	H	M			M			M
CO5					H	H	H	M			M			M

H- High; M-Medium; L-Low

E. Course content:

UNIT I INTRODUCTION TO COMPUTER ETHICS

3

What is Computer Ethics? – Why Computer Ethics? - Technology and Ethics - Computer Ethics and Morality - Ethical Decision making in computing - Computers used in Social Context - Moral and Legal issues - Computing Field as Profession – Expert Knowledge – Autonomy – Internal Governance – Service to Society – Computing considered as a Profession.

UNIT II PRIVACY AND COMMUNICATIONS

3

Privacy Risks and Principles – Expectation of Privacy and Surveillance Technologies – Business and Social Sectors – Protecting Privacy: Technology – Markets – Rights and Laws – Communications: Wiretapping and Email Protection – Designing Communications systems for Interception.

UNIT III INTELLECTUAL PROPERTY IN COMPUTER ETHICS

3

What is Intellectual Property? – Challenges of New Technologies – Ethical Arguments about Property – Search Engines and online libraries – Patent for Inventions in Software – Patent Decisions – Confusion – Consequences – Protecting Intellectual.

UNIT IV CRIME WORK AND SECURITY

3

Hacking and Hacker Ethics – Hacktivism or Political Hacking – Hackers as Security Researchers Hacking as Foreign Policy – Security – Law for catching and punishing Hackers Impacts on Employment – Employee communication and Monitoring.

UNIT V SOCIAL COMPACTS IN EVALUATING TECHNOLOGY

3

Digital Divide – Trends in computer access - Making decisions about technology – Computers and Business: Computerized Workplaces – Telecommuting – Intelligent

Machines: Artificial Intelligence – Robotics -Computers and Health: Technostress – Medical Robots – Telemedicine – Computers and Entertainment: Virtual Reality – Computer Games -Internet Pornography

TOTAL: 15

G. Learning Resources:

i. Text Books:

1. Sara Baase, "A Gift of Fire Social, Legal, and Ethical Issues for Computing Technology" Fifth Edition, Pearson Publication.
2. Deborah G.Johnson "Computer Ethics" Third Edition, Prentice Hall.

ii. Reference Books:

1. Giannis Stamatellos "Computer Ethics: A Global Perspective",1st Edition, Jones & Bartlett.